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National Aeronautics and Space Administration

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-15556# Aberdeen Proving Ground, Md. Exterior Ballistics Lab.

WIND TUNNEL FORCE TESTS OF SATURN V CONFIGURATIONS AT SUPERSONIC MACH NUMBERS

Neil A. Zarin Aug. 1964 86 p
(BRL-MR-1584; AD-452672)

Wind-tunnel force tests were performed on scale models of Saturn V configurations. The static stability and drag characteristics of these configurations were determined at Mach numbers from 1.75 to 5.00 and at angles-of-attack from −4 to +15 degrees. The results are summarized and discussed at zero angle-of-attack. Author

N65-15612*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AERODYNAMIC LOAD DISTRIBUTIONS FOR THE PROJECT FIRE CONFIGURATIONS AT MACH NUMBERS FROM 0.25 TO 4.63

Ralph J. Muraca Washington, NASA, Feb. 1965 31 p refs
(NASA-TN-D-2604) OTS: HC $2.00/MF $0.50

A wind-tunnel pressure-distribution study was made to determine the aerodynamic characteristics of two cone-cylinder-frustum configurations from Mach numbers 0.248 to 4.630 over the angle-of-attack range from 0° to 8°. The results of the reduction of the tunnel pressure data to distributed normal-force derivatives, axial-force coefficients, shear-coefficient derivatives, and moment-coefficient derivatives are presented in this report. Data are analyzed in the light of linearity with angle-of-attack, local perturbations around discontinuities, axial-force contribution to moment coefficient, and comparison of integrated pressure data with force data from other investigations. The results of these comparisons indicated that local nonlinearities do not appreciably affect the linearity of the total coefficients. Furthermore, for angles-of-attack less than 8°, the assumption of a linear relationship between the aerodynamic coefficients and angle-of-attack is valid. Author

N65-15613*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AERODYNAMIC CHARACTERISTICS OF LENTICULAR AND ELLIPTIC SHAPED CONFIGURATIONS AT A MACH NUMBER OF 6

J. Wayne Keyes Washington, NASA, Feb. 1965 29 p refs
(NASA-TN-D-2606) OTS: HC $2.00/MF $0.50

Force and moment data were obtained for two groups of lifting reentry configurations. One group consisted of five elliptic-lenticular configurations, and the other group consisted of five three-dimensional ellipsoid configurations. The thickness-chord ratio varied from 0.3 to 0.9 for both groups. The results of the investigation indicated that, in general, all of the configurations were statically unstable at angles-of-attack near 0° with the center of gravity at 50% of the maximum chord. A forward movement of the center of gravity to 40% chord resulted in a stable condition at 0° for thickness-chord ratios greater than about 0.72 for the elliptic-lenticular configurations and about 0.77 for the three-dimensional ellipsoid configurations. All of the configurations were stable near the 90° angle-of-attack for both center-of-gravity locations. However, the configurations were less stable with increasing thickness-chord ratio. Author

N65-15695# Curtiss-Wright Corp., Wood-Ridge, N.J. Wright Aeronautical Div.

HIGH TEMPERATURE TURBINE COMPONENT DEVELOPMENT FOR TRECOM SMALL GAS TURBINE ENGINE PROGRAM Monthly Technical Report No. 7

15 Jan. 1965 9 p
(Contract DA-44-177-AMC-182(T))
(WAD-R-419-7)

A preliminary turbine aerodynamic analytical design for a small gas turbine engine was completed. Work on the thermal design for the stator vane and rotor blade continued, and their cooling air supply pressures were fixed at 100 and 65 psia, respectively. A simulated cascade rig blade airfoil was produced. The fabrication of all parts for blade row temperature profile testing was completed, and modifications to the test cell for initial cascade testing were made. Five spar castings for the blade assembly were inspected and found acceptable. The airfoil skin material was flow checked at three different pressure differentials to insure their uniform flow characteristics. Calculations of the effect of flame radiation on the cascade blade temperature showed that the inclusion or neglect of flame radiation resulted in a variation of 50° F in calculated temperatures at any given point. G.G.

N65-15962# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SIMULTANEOUS EFFECT OF REYNOLDS AND MACH NUMBERS ON THE AERODYNAMIC PROPERTIES OF PLAIN COMPRESSOR BLADE GRIDS

C. Lakomy 1 Dec. 1964 25 p refs Transl. into ENGLISH from Strojirenstvi (Prague), v. 13, no. 9, 1963 p 661–668
(FTD-TT-64-104/1+2; AD-454393)

An aerodynamic wind tunnel was installed to measure flow media at very high velocities. The tunnel was also used for investigating plain blade grids of axial turbocompressors. Reliable experimental data were derived on the effect of Reynolds and Mach numbers on the operation of the compressor. The investigation equipment and measuring method are briefly described. Measurement results are thoroughly analyzed and compared with theoretical values. Author

N65-16045# Curtiss-Wright Corp., Wood-Ridge, N.J. Wright Aeronautical Div.

HIGH TEMPERATURE TURBINE COMPONENT DEVELOPMENT FOR TRECOM SMALL GAS TURBINE ENGINE PROGRAM Monthly Technical Report No. 4

15 Oct. 1964 32 p
(Contract DA-44-177-AMC-182(T))
(WAD-R-419-4)

A preliminary turbine performance map was generated. Preliminary turbine mechanical design work was directed toward completion of the stator and rotor blade airfoil configurations. Design point aerodynamic data were used to establish spanwise distributions of the gas bending moments of both the stator and the rotor airfoils. Design analysis of the final stator blade, which is structurally cantilevered from the outer support housing, indicates a conservative allowable stress margin. Rotor blade airfoil stacking, taking into consideration both centrifugal lean and gas bending moment effects, was also completed. An analysis of a labyrinth seal indicated that, for this seal which controls the rotor blade cooling air, a radial clearance of less than 0.002 inch would be required to limit leakage. The locations of the interstage bleed line and two pressure measurement lines are shown. A heat transfer analysis of the turbine disc, shaft, bearings, and the support housing was completed; and the thermal and aerodynamic analyses of the exhaust ducts are reported. D.E.W.

N65-16046# Curtiss-Wright Corp., Wood-Ridge, N.J. Wright Aeronautical Div.

HIGH TEMPERATURE TURBINE COMPONENT DEVELOPMENT FOR TRECOM SMALL GAS TURBINE ENGINE PROGRAM Monthly Technical Report No. 6

15 Dec. 1964 13 p
(Contract DA-44-177-AMC-182(T))
(WAD-R-419-6)

Calculation of external pressure and velocity profiles at the stator vane hub, mean, and tip was completed, and the profiles are shown graphically. Progress on the preliminary turbine mechanical design is described as to thermal design of the rotor blade and analyses of the turbine blade and vane. A survey of commercially procurable turbine loading system components revealed a high-power water brake and a speed reducer that can be used for the high-temperature test program. Experimental evaluations are reported on fabrication of airfoil skin material to a simulated blade preform, and various aspects of the cascade rig. Work on the detail design of the turbine test rig included formal stress analysis of the turbine rotor split disk configuration, recalculation of the rotor critical speed, and detail design of all available combustor components. D.E.W.

N65-16112# Therm Advanced Research, Inc., Ithaca, N.Y.

THE DUCTED PROPELLER IN STATIC AND LOW-SPEED FLIGHT

M. D. Greenberg and D. E. Ordway Oct. 1964 59 p refs
(Contract Nonr-4357(00))
(TAR-TR-6407; AD-608526)

A theory is developed for the steady aerodynamic loading on a ducted propeller with finite blade number in static and low-speed flight. The interaction of the higher harmonics with the steady loading is clarified and it is shown that, in a rigorous sense, a high blade-number restriction is required. For a shroud of small camber and zero thickness an analytic solution is obtained, together with simple expressions for shroud thrust and surface pressures, subject to a constant-pitch assumption on the trailing propeller vortexes. To be more precise, the pitch hypothesis is dropped and an alternative iterative solution pursued. The final results, however, of an illustrative calculation, indicate that the two solutions do not differ significantly. Results of a limited comparison with experiment are quite reasonable. Author

N65-16172# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

RESULTS OF STUDYING THE FLOW THROUGH GRIDS OF TURBINE BLADES OF GREATER DEGREE OF REACTIVITY AT VELOCITIES EXCEEDING THE SPEED OF SOUND

J. Smigielski, A. Zabicki, and J. Dudzisz 16 Nov. 1964 19 p refs Transl. into ENGLISH from Prace Inst. Maszyn Przeplywowych (Warsaw), no. 13, 1963 p 19–36
(FTD-TT-64-389/1+2; AD-608452)

Model grids consisting of sectional profiles were investigated statically in a high-velocity tunnel to determine whether the planned turbine blade arrangement would permit realization of the intended flow-through intensity. Control grids and impeller grids were studied. Measurements were made of the input static pressure using both Pitot-probe and wall-aperture methods, of the output static pressure using a cylindrical sliding probe for measurements near the sidewalls and a wall aperture for channel-center measurements, and of the output angle from the grid using a differential probe and optical protractor. Calculations to ascertain to what extent the maximum Mach number value can be predicted were made, and the results compared to the values obtained experimentally. D.S.G.

N65-16298# Air Force Systems Command, Eglin AFB, Fla. Research and Technology Div.

ROLL SPEED-UP ANALYSIS FOR HIGH ALTITUDE SOUNDING ROCKETS

Dewey E. Calfee Nov. 1964 36 p refs
(ATL-TR-64-76; AD-453761)

The analysis, made of the steady-state spin rate obtained by mounting wedges on flat-plate fins, involves calculations of local flow field properties in the vicinity of the wedges with the aid of certain simplifying assumptions concerning shock-wave-boundary-layer interaction. A hypothesis is presented of a flow mechanism that can be used to compute the steady-state spin rate which is very similar in characteristics to the roll speedup phenomenon actually observed during the coast period of high-altitude research rockets. Theoretical spin rates are compared with measured spin rates for the case in which the roll speedup phenomenon was observed, and again for the case in which the phenomenon was not observed. Author

N65-16324# Aircraft Research Assn., Ltd., Bedford (Gt. Brit.)

TEST PROPELLERS IN THE S-1 WIND TUNNEL AT THE ONERA TEST CENTRE OF MODANE

Guy Leclère Dec. 1964 18 p ref Transl. into ENGLISH from Rech. Aerospatiale (France), no. 90, May–Jun. 1964
(ARA-Transl-9)

A testing device for high-speed, large-scale propellers was designed and developed that permits the measurement of forces and moments in a wind tunnel either when nacelles are reproduced or when a cylindrical body is used as minimum support. The first configuration of the study of propellers in engine-nacelles uses as its support the balance already installed for testing engines, and reaches incidences from 0° to 10°. The second configuration is designed to verify calculations of propeller performance and allows tests at 5° to 10° incidence. Tests were carried out for both configurations at pitch steps and constant speeds, and by sweeping at increasing and decreasing speeds. The obtained results show the advantage of the mounting elements of the aircraft close to the propeller since they influence directly conditions of velocity and local incidence in the plane of the propeller. G.G.

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-15726# General Electric Co., Cincinnati, Ohio. Flight Propulsion Div.
LIFT/CRUISE FAN EXHAUST SYSTEM RESEARCH PROGRAM
W. A. Fasching Ft. Eustis, Va., Army Transportation Res. Command, Sep. 1964 218 p refs
(Contract DA-44-177-AMC-74(T))
(TRECOM-TR-64-49; AD-609058)

An experimental investigation was conducted to obtain design data for low-pressure-ratio lift/cruise fan exhaust systems. The testing was accomplished in a wind tunnel test facility. The test results of conical convergent and plug nozzle scale models are presented and evaluated. The test data provide valuable design information for lift/cruise fan nacelle installations. The important results and conclusions are as follows: (1) High thrust-minus-drag Mach 0.8 cruise performance (C_{T-D} = 0.965) was demonstrated at a low nozzle pressure ratio of 1.94 for both conical and plug nozzle lift/cruise fan nacelle installations having a throat area to maximum model area ratio (A_B/A_M) of 0.43. (2) For cruise Mach numbers over 0.85, conical nozzle installations perform better than plug nozzles for the investigated nacelle installation. (3) Friction drag plays a predominant role in the optimization of lift/cruise fan nacelle installations. Author

N65-15758# Kellett Aircraft Corp., Willow Grove, Pa.
EFFECTS OF AIRFRAME GEOMETRY ON DOWNWASH PROBLEMS OF TANDEM DUCTED-PROPELLER VTOL AIRCRAFT
R. R. Pruyn Jan. 1964 125 p refs
(Contract NOw-61-0926-c)
(Rept.-179T80-6; AD-452792)

A full scale half-model simulation of a dual tandem ducted propeller VTOL aircraft was tested at heights of less than two duct diameters above sand and water terrain. Data on terrain transport, terrain-caused aircraft damage, flow-field measurements and ducted propeller performance were obtained. These tests were conducted at propeller disc loadings up to 60 lb/sq. ft with various aircraft configurations and ducted propeller orientations. The dual tandem configuration was found to cause a significant increase in downwash problems compared to isolated propeller configurations previously tested. Reduced performance, severe engine and propeller damage and an oscillating aerodynamic interference were experienced. Several promising devices to alleviate downwash problems were evaluated. Author

N65-15811# Gyrodyne Co. of America, Inc., St. James, N.Y.
THEORETICAL STUDY OF GYRO-STABILIZED FLOAT CONCEPT FOR AMPHIBIOUS HELICOPTERS
Nov. 1964 95 p refs
(Contract NOw-63-0463-c)
(RD-47-313400-1; AD-455334)

A theoretical study was conducted of a concept for automatically stabilizing a water-based helicopter when afloat by means of movable floats. Results of the study indicated that the concept is feasible, and that power requirements for stabilization are within acceptable limits. It is recommended that the investigation be pursued into the model test phase. Author

N65-15871# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVELOPMENT OF AIRCRAFT
V. F. Bolkhovitinov 14 Aug. 1964 164 p refs Transl. into ENGLISH from the publ. "Puti Razvitiya Letatel'nykh Apparatov" Moscow, Gos. Nauchno-Tekhn. Izd., 1962 p 1–130
(FTD-MT-64-150; AD-608242)

The history and development of aviation covers theoretical problems involved, the criteria of effectiveness, and the main factors of combat efficiency of aircraft. A discussion of the development of helicopters and manned missile flights is included. Conclusions reached were that a consideration of the properties of targets and of weapons was necessary to solve tactical and strategic problems. Points of consideration for targets are dimensions, strength, remoteness, defense, detectability, camouflage, and determination of coordinates of targets. Considerations for weapons are the possibility of detection, accuracy of hit, form of striking weapon, invulnerability in air and on the ground, vulnerability of ground means of servicing, and dependence on intelligence and transportation. R.E.S.

N65-15879# Aviation Safety Engineering and Research, Phoenix, Ariz.
CRASH INJURY EVALUATION: PERSONNEL RESTRAINT SYSTEMS STUDY, UH-1A AND UH-1B BELL IROQUOIS HELICOPTERS, SUPPLEMENT
Ft. Eustis, Va., Army Transportation Res. Command, Mar. 1964 22 p
(Contract DA-44-177-AMC-888(T))
(AvSER-62-27; TRECOM-TR-63-81, Suppl.; AD-608189)

Included are engineering drawings covering a personnel restraint system, and its installation for the UH-1A and UH-1B Iroquois helicopters. R.L.K.

N65-15883 Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
ADVANCED FLIGHT CONTROL SYSTEM CONCEPTS FOR VTOL AIRCRAFT, PHASE I

Rene H. Miller et al Ft. Eustis, Va., Army Transportation Res. Command, Oct. 1964 203 p refs
(Contract DA-44-177-TC-757)
(TRECOM-TR-64-50; R-428; AD-609553)

Described are the the results of a research program to develop practical control systems providing optimum control characteristics for VTOL aircraft under all conditions. Control system requirements are developed from an analysis of the VTOL flight control problem. Possible advanced system concepts are described, and the evaluation of these concepts using a fixed base flight simulator is reported. The results indicate the desirability of controlling ground velocity during hovering and low speed flight, and aircraft attitude during cruise flight. The analytical design of a self-contained inertial velocity measuring system to provide the required indication of ground velocity is presented. The design of an experimental flight control system for a tandem rotor helicopter is described in detail, and a flight test program to evaluate the control system concepts using the experimental equipment is outlined. Author

N65-16030# North American Aviation, Inc., Columbus, Ohio. Engineering Dept.
MODEL RA-5C AIRPLANES Biweekly Flight Test Summary Reports Through Report No. NA-58H-210-243, Quarterly Index
31 Mar. 1964 13 p
(Contract NOw-63-0720)
(NA-624-195-9; NA-58H-210-243)

This report presents a general subject index to topics in flight test summary reports; it is arranged by the decimal system, and indicates the major categories of the detailed subject index. In the detailed index, each major category is subdivided into detailed subtopics, under which specific reports are listed. D.E.W.

N65-16061# General Mills, Inc., St. Paul, Minn. Electronics Div.
DETERMINATION OF THE SHAPE OF A FREE BALLOON Scientific Report No. 2
Justin H. Smalley 31 Dec. 1963 59 p *Its* Rept.-2500
(Contract AF 19(628)-2783)
(AFCRL-64-734; AD-610125)

Presented are the numerical methods used and the results of the computation of the shapes of axisymmetric free balloons. Flat-top balloons, reentrant top balloons, and double balloons, all with zero circumferential stress and zero superpressure at the bottom apex, are considered. Meridional film loads are presented. An extensive Sigma Table suitable for balloon design is included for the flat-top balloon with $\Sigma = 0(0.05)\ 1.0$. Author

N65-16093# Air Force Flight Test Center, Edwards AFB, Calif. Aerospace Research Pilot School
PERFORMANCE FLIGHT TESTING THEORY
George D. Hendrix, Orgle D. Godwin, Frank D. Frazier, and Rodney E. Durnin [1964] 92 p
(FTC-TIH-64-2005; AD-609489)

A student handbook is presented with the following areas of consideration: (1) the atmosphere in terms of divisions and limits, and the measurements needed in flight; (2) the instrumentation in terms of the capability of measuring altitude, airspeed, Mach number, ambient air temperature, and instrument lag due to pressure change; (3) the pitot-static system theory in terms of in-flight errors, and standard methods of correction; (4) the nonsteady-state performance in the areas of the best climb speed schedule of the aircraft, the capabilities of climb and acceleration in reference to changing altitude conditions; (5) the turning performance in relation to the computations of forces acting on the craft; (6) the steady-state performance pertaining to level unaccelerated flight where all forces must equal zero; (7) the fuel flow correction in terms of the effects from velocity, rpm, pressure, temperature, and relative engine diameter; and (8) the takeoff and landing theory in terms of both air phase and ground phase. R.E.S.

N65-16096# Schjeldahl (G. T.) Co., Northfield, Minn.
POLYPROPYLENE BALLOON STUDY Annual Report
J. A. Mac Fadden 29 Oct. 1964 80 p
(Contract Nonr-4096(00))
(AD-608098)

A theoretical design study of a polypropylene balloon, a testing program to evaluate fittings and material, model balloon tests, and a full-scale static inflation test were completed. Evaluation of the premature failure of the full-scale static test balloon showed that, although fabrication of a polypropylene balloon is possible, fabrication techniques need further study. It is possible to seal gores together with tape, and laboratory samples of inflation tubes and duct accessories are good. However, on the basis of current knowledge, the economic practicality of fabricating an unsupported polypropylene balloon is uncertain. D.E.W.

N65-16294# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE SMALLEST AIRCRAFT HAVE THE GREATEST PROMISES
Pavel Sterc 9 Jan. 1965 7 p Transl. into English from Letecky Obzor (Prague), v. 8, no. 5, 1964 p 136–137
(FTD-TT-64-849/1; AD-455530)

The development of various concepts of smaller aircraft with the help of amateur groups and builders is advocated, and a promising future for helicopters, gliders, single seaters, autogyros, inflatable minute aircraft, and water gliders is projected. G.G.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-15545# Mallory (P.R.) and Co., Inc., Burlington, Mass. Lab. for Physical Science
CELL EQUALIZATION TECHNIQUES Quarterly Technical Progress Report, 1 Jul.–1 Oct. 1964
F. J. Cocca [1964] 33 p
(Contract AF 33(615)-1342)

Hermetically sealed Ni–Cd cells were cycled with and without stabistor charge control. The capacity range used was 5 to 20 ampere-hours. In the four charge control circuits, BCC-9, BCC-10, BCC-11 and BCC-12, the stabistors were effective in clamping cell voltages and minimizing gassing. In BCC-11, 20-AH Ni-Cd cells were cycled, and the stabistors were effective in preventing internal cell shorting and extending battery life. Antireversal studies were also conducted, and initial

results indicated that antireversal diodes are partially successful in preventing gassing during cell reversal. The data suggested the use of a larger antireversal diode for adequate protection. Author

N65-15555# Frankford Arsenal, Philadelphia, Pa.
DEVELOPMENT OF DUAL ACTUATED FIRING MECHANISMS FOR INITIATORS
William R. Peterson Nov. 1964 34 p
(R-1741; AD-452175)

Two types of dual-actuated firing mechanisms were designed, developed, and tested in initiator assemblies. One mechanism, combining the mechanical with the propellant-gas actuation, was assembled with the standard miniature initiator delay cartridge and combustion chamber components. The other, a dual-gas-actuated mechanism, was assembled with the standard miniature initiator cartridge, M91, and the matching combustion chamber. Detail drawings were prepared, components were fabricated, and the devices were tested satisfactorily over the temperature range of −65° to 200° F. It was concluded that the dual-actuated initiators are safe, efficient, and reliable units, meeting all functional requirements. Adaptation of these initiators to existing or future aircraft escape systems would result in an appreciable reduction of weight. It is recommended that a final engineering test program be conducted so that they may be considered for standardization as PAD items. Author

N65-15702# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Space and Defense Sciences Dept.
5 KW HYDROCARBON-AIR FUEL CELL SYSTEM Semi-annual Technical Summary Report, 1 Feb.–11 Jun. 1964
Merle L. Engle 30 Jun. 1964 32 p ref
(Contract DA-44-009-AMC-240(T); ARPA Order 430)
(AD-451438)

Fuel cell development was concentrated on building single cells with acceptable power output and reproducible cell performance. Work on the catalyst and electrode program has continued with testing of various nickel and silver electrodes and catalyst combinations. A standard screening test for catalysts and electrodes was established. Nickel electrodes were tested along with electrodes made from silver. Fuel cell air manifolding proved to be a critical item in multiple cell modules. Early tests on the 20-cell module showed large variations in airflow through individual cells of the module. This resulted in poor power distribution and moisture control among the cells. An increased effort was directed to individual cell air manifolding and cell stack manifolding. Airflow as high as 14.5 scfm was scrubbed 62% to 90% free of CO_2 in a scrubber chamber volume of less than 0.2 ft^3. This flow is 30% in excess of that required at full load operations. Tests were begun on various system components, such as the main compressor and motor, CO_2 scrubber, and KOH recirculating pump for the scrubber. Author

N65-15711*# Space Technology Labs., Inc., Redondo Beach, Calif.
SPACECRAFT ELECTRIC POWER SYSTEM SIZING AND ANALYSIS COMPUTATIONS Final Report, Jul. 1963–Feb. 1964
Herbert Riess, Ralph L. Robinson, Hampden O. Banks, Jr., Paul Bauer, and William G. Binckley 15 Mar. 1964 372 p refs Prepared for JPL
(Contract NAS7-100)
(NASA-CR-60357; STL-8584-6001-RU000) OTS: HC $7.00/MF $2.00

This report presents a method of empirically designing electrical power systems that utilize solar energy based upon present-day technology. It includes computation procedures suitable for computer programing. Power ratings of the systems investigated are within the 100 to 1000 watt range. Covered are the following: Power Source—photovoltaic, flat-plate thermoelectric, thermionic, and dynamic; Energy Storage—silver–zinc and silver–cadmium batteries; and Power Conditioning—inverters. A summary of current developments on system components includes the source of the information, an estimate of its validity, and an identification of gaps in the technology concerned. Typical data, obtained either from the manufacturers or from user agencies, are presented in parametric form. For each major system component, a computation procedure in the form of a flow diagram is presented. Author

N65-15747*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF A 3.0-INCH-MEAN-DIAMETER FULL-ADMISSION THREE-STAGE TURBINE SUITABLE FOR SMALL AUXILIARY POWER UNITS
Robert Y. Wong and William J. Nusbaum Washington, NASA, Feb. 1965 24 p refs
(NASA-TN-D-2639) OTS: HC $1.00/MF $0.50

The turbine was designed for an equivalent specific work output of 43.6 Btu per pound, an equivalent weight flow of 0.060 lb/sec, and an equivalent rotative speed of 30 000 rpm. The performance of this turbine is compared with that of a reference two-stage turbine designed for the same requirements and with 31.34% admission in the first stage and full admission in the second stage. A total-to-static efficiency of about 0.64 was obtained for the three-stage turbine at design blade–jet speed ratio. This value of efficiency compares favorably with a value of 0.65 calculated from an aerodynamic efficiency of 0.69 to account for large leakages through the second-and-third-stage stator seals. Comparison of the performance of the three-stage turbine with the reference two-stage turbine indicated that the three-stage turbine with the high leakage seals performed as well as the best of the various configurations of the two-stage turbine. Author

N65-15759# Yardney Electric Corp., New York, N.Y.
DEVELOPMENT OF THE SEALED ZINC-SILVER OXIDE SECONDARY BATTERY SYSTEM Fourth Quarterly Progress Report, 1 Apr.–30 Jun. 1964
Martin Sulkes and George A. Dalin [1964] 50 p refs
(Contract DA-36-039-AMC-02238(E))
(Rept.-4; AD-453792)

Nine months' wet discharged stand did not affect the performance of sealed cells except for the first cycle after the stand. Sealed cells gave improved cycle life and capacity maintenance over unsealed cells of the same construction. Data are presented on the physical and chemical properties of some separators. Negative electrode shape change was reduced and cycle life increased by the use of low concentrations of KOH, i.e., 26.5% with an all PVA separator. With a C19(300) separator, cycle life falls as the electrolyte concentration is lowered, due to increased chemical attack on the separator even though shape change is reduced. Good capacity was obtained at high rates of charge by the use of either 6 or 11 mil Pellon interseparator and/or a highly porous positive electrode. Cells were built with various amounts and types of negative electrode binders; other cells were built with continuous cadmium grids in the negative electrode. Author

N65-15773# General Motors Corp., Santa Barbara, Calif. Land Operations Dept.
STUDY OF A THERMOPHOTOVOLTAIC CONVERTER Second Quarterly Progress Report, 11 Aug.–10 Nov. 1964
Jan. 1965 49 p refs
(Contract DA-28-043-AMC-00067(E))
(TR65-03; AD-454940)

The system has an inner cylindrical mantle (3.75 cm radius) heated internally by conventional fuels, a concentric cylindrical photocell mount (12.5 cm radius), and reflecting end mirrors. Convective losses are 0.04 kW to each mirror. Germanium n-on-p^+, 7-finger gridded photocells were antireflection coated (minimum reflectivity at 1.5μ). Measurements before coating are 37.5% reflectivity at 1.5μ, I_{sc} = 2.75 ±0.35 A and typically, 0.225 V, 1.8 A, 0.40 W at maximum power. Measurements after coating are zero reflectivity at 1.5μ, I_s = 4.05 ±0.35 A and, typically, 0.23 V, 2.9 A, and 0.65 W at maximum power. Development of the nonabsorptive cell proceeds in two directions. The first is the junction grid design. Methods included (1) In-Ga solder under the grids to form the doped, patterned layer, (2) a carbon mask to define the pattern, plus an alloy, (3) a metal etch resist to define the pattern, using a neutral metal, then metallizing that pattern with indium alloy, and (4) vacuum deposition through a mask followed by alloying in a furnace. Each method met with some difficulty. The second direction is an alloying technique, and from this the first nonabsorptive cells were produced. Measurements are 40% transmission from 2.2-5μ, and 0.18 V, 1.8 A, 0.32 W at maximum power, with a curve factor of 0.44. Author

N65-15796# Massachusetts Inst. of Tech., Cambridge.
BASIC APPLIED RESEARCH IN FLUID POWER CONTROL Eighth Progress Report, Feb. 1–May 31, 1964
H. H. Richardson et al 3 Sep. 1964 94 p refs *Its* Rept.-8998-8
(Contract AF 33(657)-7535)
(FDL-TDR-64-127; AD-609652)

This report presents technical results and describes progress in several phases of continuing applied research and development related to the design and development of high-performance fluid control devices for advanced aerospace systems. Continued emphasis is placed on pneumatic components and systems capable of performing over wide ranges of temperature and in the presence of intense radiation. Also described is current work dealing with a new pulse actuation servosystem, a pneumatic pulse-length-modulated servosystem, the dynamics of fluid jet modulators, electrostatic pure fluid modulation, jet pipe inlet coupling, compressible dampers, and gas-lubricated bearings. Author

N65-15810# Electrochimica Corp., Menlo Park, Calif. Research and Development Lab.
DIRECT AMMONIA-AIR FUEL CELL Final Report, 1 Jul. 1963–31 Aug. 1964
Robert E. Kuppinger [1964] 76 p refs
(Contract DA-36-039-AMC-03245(E))
(Rept.-4; AD-454420)

A new type of direct oxidation ammonia fuel cell was investigated. This cell is based on the use of a nonaqueous fused hydroxide electrolyte matrix, and operates in the intermediate temperature range of 180° to 300° C. Studies were carried out to determine the nature of the rate-controlling step in the kinetics of the anodic oxidation of ammonia. A new type of Ni/NiOOH reference electrode was developed for the measurement of single electrode potentials in experimental galvanic fuel cells employing this type of matrix electrolyte. In addition to various exploratory studies, two statistical analysis programs, using a full factorial design and replicate blocks of cells, were applied to the electrochemical parameters of temperature, composition, current density, and cell aging. Operational cells were able to reach current densities of 100 to 120 mA/cm^2 at cell EMF's of 0.5 to 0.6 V. At practical levels of current density the direct ammonia fuel cell has an overall efficiency of about 60% compared to 30% to 35% for the indirect-type fuel cell. The effect of byproduct water formation on cell life and performance was studied along with possible methods of effective removal, for further development of the system. Analysis of water mass transport phenomena indicates the approaches that need to be taken for further improvements of the direct ammonia fuel cell system toward practical performance levels. Author

N65-15813# Textron Electronics, Inc., Sylmar, Calif. Heliotek Div.
HIGH EFFICIENCY SILICON SOLAR CELLS Final Report, Jun. 15, 1962–Jul. 15, 1964
Paul A. Berman [1964] 155 p refs
(Contract DA-36-039-SC-90777)
(Rept.-8; AD-454009)

Experiments leading to an optimized design for N^+/P and P^+/N solar cells that are to be utilized in a terrestrial environment at a solar intensity of about 350 mW/cm^2 are described. The same cell design is shown to be optimized for 100 mW/cm^2 earth's surface solar intensities as well. It is found that the results of the experiments can be predicted from theory to a good approximation. Pilot line production of cells utilizing the optimized design is described, and yield distributions are presented. Good efficiency yields are found to occur for both polarities; however, the yield distribution of the P^+/N cells is superior to that of the N^+/P cells. The yield distributions are discussed in the light of further analysis of the electrical characteristics of the cells. The utilization of low-cost starting material in the fabrication of high and moderately high efficiency solar cells is discussed. Also presented are data on pilot line yield distributions of these cells, and their behavior at concentrated solar intensities. The results of other attempts to decrease solar cell costs, such as replacement of the junction cleanup etch by a sandblasting operation and fabrication of large area cells, are presented and discussed. Author

N65-15814*# General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
CHARACTERIZATION OF NICKEL-CADMIUM ELECTRODES Fifth Quarterly Report, 1 Jul.–1 Oct. 1964
[1964] 42 p
(Contract NAS5-3477)
(NASA-CR-60418) OTS: HC $2.00/MF $0.50

The objective is to develop a method of analysis and characterization of the electrodes used in nickel–cadmium sealed cells. It is based primarily on a comparison of detailed polarization measurements of single electrodes before and after periodic operation in selected modes of cyclic testing of cells at three temperature levels 0°, 25°, and 40° C. A correlation of this data should provide a basis for specifying improved cells for space applications as well as comparing cells from various manufacturers. Random discharge tests (RA) and constant voltage, current limited charging cyling tests (RB) were continued. Shallow discharge (CC) test electrodes were examined by X-ray diffraction, photomicrography, electrochemical capacity evaluation and recharacterization tests. Author

N65-15823*# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Electromechanical Div.

BRAYTON CYCLE CAVITY RECEIVER DEVELOPMENT Quarterly Report, Apr.–Jun. 1964; Jul.–Sep. 1964

[1964] 61 p refs

(Contract NAS3-2779)

(NASA-CR-60398; ER-6102) OTS: HC $3.00/MF $0.75

Described are the continuation of the first 2500-hr furnace test, the examination and analysis of the two TD nickel capsules removed after the third interruption, and the continuation of additional corrosion testing and the design study. The results are in tabular form and include the completion of furnace testing for material corrosion on two furnaces; small-scale experiments to provide heat input and heat-release characteristics of lithium fluoride; and calculations of the bath variable thermal resistance for the cavity surface temperature, including 2% allowable gas-pressure drop, full-scale cavity receiver design, aperture control analysis, and cavity temperature distribution. Existing computer programs were reviewed, and changes required were identified. R.E.S.

N65-15882*# Aeronutronic, Newport Beach, Calif. Applied Research Lab.

DEVELOPMENT OF A HIGH TEMPERATURE BATTERY Second Quarterly Technical Report

W. J. Subcasky, D. N. Stamires, T. M. Place, G. Segovia, R. G. Salisbury et al 15 Jan. 1965 64 p refs

(Contract NAS3-6002)

(NASA-CR-54289; U-2986) OTS: HC $3.00/MF $0.75

The resistivities of various types of synthetic zeolites having different cations were measured as a function of temperature. Of the materials NaX has the lowest resistance. The effect of various bonding techniques upon the crystal structure and resistivities of sodium zeolites was investigated. Techniques using $Na_2Si_2O_5$ or H_3PO_4 as a binding agent show increased resistances when compared to the pure zeolites. The electrochemical characteristics of $CuCl_2$, CuCl, $BiCl_3$, $FeCl_3$, and AgCl are presented. The effect of diluents added as solids or coulometrically by cationic transfer through a ceramic membrane upon the performance of certain cathode materials was investigated. Sodium was proposed as the anode material after elimination of calcium because of contact problems and lithium because of severe corrosion problems. A proposed cell design is presented utilizing various sealing and containing techniques. Compatibility tests with materials of the proposed cell were initiated and used to further define the proposed cell. Author

N65-15884# Texas Instruments, Inc., Dallas.

EXTENDED MOLTEN-CARBONATE FUEL CELL SYSTEM PROGRAM Technical Summary Report, 1 Jul.–23 Oct. 1964

J. K. Truitt and C. G. Peattie [1964] 25 p

(Contract DA-44-009-AMC-54(T))

(TI-08-64-166; AD-452636)

Reliability testing was continued. Emphasis was shifted to six-cell units from the initially used four-cell units. Problems with cells having plenum grounded cathodes were analyzed and found to be associated with excess electrolyte and damage that occurs to the anodes of the same cells during electrode fabrication. Steps to overcome both limitations are being taken. Maximum power in excess of 50 watts per square foot was observed. Two methods of thermal control are being investigated. Experimental work is planned for the simpler one, involving recirculated air. Investigation of a more complex molten sulfur coolant loop will be initiated if the air cooling method appears inadequate. Author

N65-15896# General Instrument Corp., Newark, N.J. Thermoelectric Div.

WICK BURNER FOR THERMIONIC GENERATORS Final Report, 1 May 1963–31 May 1964

C. Teleki [1964] 36 p

(Contract DA-36-039-AMC-02236(E))

(AD-454772)

A basic burner model, with an externally heated simulated diode, having a hemispherical simulated emitter surface area of 40 cm^2, was designed, fabricated and tested. The burner design incorporates a nonpressurized, wick-type gasoline vaporization system, and a heat exchanger for preheating the secondary combustion air by means of the hot exhaust gases. A number of different combustion chamber designs were tested to determine the optimum configuration. Conservative measurements indicated attainment of temperatures above 1500° C on the hemispherical simulated emitter surface with an average heat flux of 40 W per cm^2. Preliminary burner testing was performed on a small-scale unit for a simulated diode having a flat simulated emitter surface area of 2.86 cm^2. Tests performed on this unit resulted in a simulated emitter surface temperature of 1415° C at a heat flux of 51 W per cm^2. Author

N65-15944*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OFF-DESIGN PERFORMANCE PREDICTION WITH EXPERIMENTAL VERIFICATION FOR A RADIAL-INFLOW TURBINE

Samuel M. Futral, Jr. and Charles A. Wasserbauer Washington, NASA, Feb. 1965 29 p refs

(NASA-TN-D-2621) OTS: HC $2.00/MF $0.50

A method for predicting the off-design performance of a radial-inflow gas turbine is presented. The equations used were programed for a digital computer. Input to the program must include the turbine geometry and dimensions. The efficiency, pressure ratio, speed, and weight flow at a given operating point are necessary in order to evaluate the loss coefficients. Predicted performance is given for a 4.5-inch-diameter commercial turbine. Comparison of predicted with experimentally determined performance for this turbine showed good agreement. Radial turbine performance differs from that of the axial turbine because of centrifugal forces set up by the radius change. Thus, weight-flow and, consequently, stator-flow conditions and rotor incidence loss are more sensitive to speed than in axial machines. The operating range is therefore limited by the centrifugal forces that cause flow and specific work to become negative at blade-jet speed ratios near 1.0. Author

N65-15951*# Bendix Corp., South Bend, Ind. Bendix Products Aerospace Div.

PNEUMATIC NUTATOR ACTUATOR MOTOR Second Quarterly Report

C. N. High, G. R. Howland, and J. R. Williamson 31 Dec. 1964 45 p

(Contract NAS3-5214)

(NASA-CR-54282; BPAD-864-15598R) OTS: HC $2.00/MF $0.50

This report describes the accomplishments of a program to develop a pneumatic actuator motor of a new concept. The actuator motor operates from a pneumatic power supply and produces a high torque, low speed mechanical output proportional to a pneumatic input pressure differential signal. The commutation logic of the motor is accomplished by closed loop fluid interaction (vortex-type) devices. The fabrication status of the mechanical and commutation circuit components is given. Further test results of the breadboard commutation circuit are presented. Author

N65-15956*# Unified Science Associates, Inc., Pasadena, Calif.
GASEOUS ELECTROLYTES FOR BATTERIES AND FUEL CELLS First Quarterly Report, 21 Aug.–20 Nov. 1964
S. Naiditch, J. J. Rowlette, and E. L. Colichman [1964] 29 p refs (Contract NAS7-326)
(NASA-CR-60430) OTS: HC $2.00/MF $0.50

The objective of this program is to evaluate the applicability of dense gaseous electrolytic solutions to energy conversion. The electrochemical cell:

$Zn(Hg), ZnCl_2 \cdot 10NH_3(s), NH_4Cl$ in NH_3, $CdCl_2 \cdot 6NH_3(s)$, Cd(Hg)

was chosen to initiate this study. A pressure vessel was modified so that electrochemical cells can be subjected to an external pressure greater than the internal dense gas pressure. Preliminary electromotive force and electrical conductance measurements were obtained over the temperature range −64° to +152° C; and both liquid and gaseous electrolytic solutions were studied. No valid equilibrium EMF or conductivity data were produced as yet. Some initial runs were performed outside the pressure system at room temperature (25° C) and at −64° to −54° C to check out the electrochemical cell assembly. EMF's obtained were +0.360V at 25° C and +0.356V at −54° to −64° C. Author

N65-15999# AiResearch Mfg. Co., Phoenix, Ariz.
MASS-TRANSFER TESTS WITH TWO-PHASE FLOW
E. A. Kovacevich and R. L. Salley Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 20 Nov. 1964 140 p
(Contract AF 33(657)-8954)
(SY-5463-R; APL-TDR-64-119; AD-608565)

A closed loop, fabricated entirely from Cb + 1.0 wt% Zr material, was operated with potassium under dynamic two-phase (liquid and vapor) conditions. A test section containing orifices and Mo + 0.5 wt% Ti test specimens was placed in the vapor stream. The maximum fluid temperature of 1950° F and the maximum vapor temperature of 2000° F were maintained throughout the test. Condensing occurred at 1770° F. The test was conducted for 307 hours of the scheduled 1000 hours. The test was terminated because of a twisted ribbon failure in the boiler section, which resulted in a flow restriction. The test was conducted in a purified argon atmosphere. Despite the precautions taken to minimize contamination of the loop material, contamination of the refractory alloy existed. Under the test conditions, there was no evident corrosion and/or erosion of the loop materials. Author

N65-16101# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
UNIVERSAL ASSEMBLY OF PREFABRICATED MACHINE PARTS FOR PNEUMATIC GUIDANCE CONTROL
H. Toepfer, D. Schrepel, and A. Schwarz 28 Oct. 1964 22 p refs Transl. into ENGLISH from Messen-Stevern Regeln (Germany), v. 7, no. 2, 1964 p 63–72
(FTD-TT-64-723/1+2; AD-608461)

The assembly of a guidance control system that consists of basic logic elements containing double membrane relays, a safety switch, a manual switch, an electrical–pneumatic transformer, a pneumatic–electrical transformer, time relays, and a perforated tape scanning device is described. The construction and basic operation of the double membrane relay and its associated logic circuitry are discussed in detail. The results of endurance and reliability tests in which the individual logic elements underwent 1.2 billion switching cycles without failure and the control unit operated through 1.7 million cycles in unpurified air with no interruption are reported. Wiring procedures and diagrams for the control unit are also presented. D.S.G.

N65-16128#
PHOTOVOLTAIC CELLS WITH CONCENTRATORS [CELLULES PHOTO VOLTAIQUES AVEC CONCENTRATEURS]
P. Leclerc 20 Feb. 1964 14 p in FRENCH
(Rept.-1983)

This report is concerned with the conversion of light energy into electric power by thermophotovoltaic generators. A description of photovoltaic cells is presented. Conclusions reached are that: (1) The photovoltaic cells actually manifest a performance comparable to thermoelectric cells. (2) The cost is greater and there is a controlling effect of a source which is cold relative to the ambient temperature. (3) By resistance reduction it would be possible to make converters with superior efficiency (about 20% greater). (4) The choice of both the type and source materials is great. (5) Power densities of the order of 5 W/cm^2 are feasible and, taking into account the surrounding optical system, a power per unit volume of the order of 50 W/cm^3 would be foreseeable. Trans. by R.E.S.

N65-16156# General Motors Corp., Indianapolis, Ind. Allison Div.
THERMALLY REGENERATIVE FUEL CELLS
R. E. Henderson [1964] 15 p refs Presented at the 6th AGARD Combust. and Propulsion Colloq. Cannes, France, 16–20 Mar. 1964

The thermomechanical and the electrothermal separation methods for thermally regenerative fuel cells are described. An analysis of thermodynamically reversible fuel cell components was made, and it was found that the Carnot efficiency is the limiting factor in efficiency reduction. An experimental study of a potassium–mercury fuel cell established an optimal voltage ratio of 0.7 V and an overall system weight of 20 kg/k for the whole power system. Liquid metal systems offer the best possibility for practical application because they can: generate at a low temperature, obtain low cell polarization, and utilize electromagnetic pumps. G.G.

N65-16166# Naval Fleet Missile Systems, Corona, Calif. Analysis and Evaluations Group
MEASUREMENT OF MICROWAVE DELAY LINE LENGTH
J. J. Hoote and L. Sutton Nov. 1964 24 p
(E7-556; AD-451243)

Microwave waveguide delay lines are used to measure the sensitivity of guided missile fuzes at various simulated target ranges. These delay lines consist of diverse waveguide components such as isolators, attenuators, phase shifters, ferrite devices, etc., assembled together to form a complex microwave signal conditioning system. Two techniques were developed to measure delay line length. One technique depends upon reflections from a short. A swept microwave signal is introduced at the delay line input with the output end shorted. The resulting series of standing waves is detected and viewed on an oscilloscope. A cavity frequency meter is inserted in the line and, with the resonance pip introduced, the frequency at which the nulls occur may be measured. Knowing the swept frequency range and the number of nulls generated thereby, the unknown line length may be calculated. The second technique was developed to avoid the inherent disadvantages of the first method requiring two-way transmission. The second technique utilizes a reference signal that is propagated through a known reference line and beat with the signal from the unknown line. If the signal source is swept through some frequency range, a

series of nulls is generated by phase cancellation due to unequal lengths of the known and unknown delay lines. The nulls may be detected and viewed on an oscilloscope. A cavity frequency meter is used to measure the beginning and end frequencies of the null series. Author

N65-16177*# Harshaw Chemical Co., Cleveland, Ohio. Crystal-Solid State Div.
RESEARCH AND DEVELOPMENT IN CdS PHOTOVOLTAIC FILM CELLS Second Quarterly Report, 19 Aug.–19 Nov. 1964
T. A. Griffin, R. W. Olmsted, and J. C. Shaefer [1964] 21 p refs
(Contract NAS3-4177)
(NASA-CR-54173) OTS: HC $1.00/MF $0.50

Improvements in cell power–weight ratio, and overall efficiency were realized. Power–weight ratios of forty W per pound and efficiencies of 3.5% were observed consistently. Different methods of plating grids and barriers were examined. The more promising of three methods were pursued with the intent of increasing cell efficiency. Film and barrier properties were examined with the objective of producing them with a more consistent uniformity. Structure and arrangement of CdS crystals within the film were examined microscopically. Various substrate materials were tried in an effort to find one lighter and more compatible with CdS films. Molybdenum remains the best to date. It was determined that CdS could be plated on conducting paper. Cell fabrication techniques were examined to improve cell efficiency and reduce fabrication time. Drawings for an impulse laminator were obtained. Author

N65-16198# AiResearch Mfg. Co., Los Angeles, Calif.
WORKING GAS SELECTION FOR THE CLOSED BRAYTON CYCLE
John L. Mason [1964] 37 p refs Presented at 6th AGARD Combust. and Propulsion Colloq., Cannes, France, 16–20 Mar. 1964
(M-1720)

Xenon–helium gas mixtures were found to provide substantial advantages over other working gases for the closed Brayton cycle. Xenon–helium mixtures provide variable molecular weights to meet turbomachinery design requirements. Over a wide range of molecular weights, xenon–helium Prandtl number is outstandingly low. The overall result is markedly advantageous to the Brayton cycle, especially at low power levels. Selective leakage of helium is a potential problem, but one well worth taking on in view of the advantages to be gained. Author

N65-16199# Société Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris (France).
THERMODYNAMICS OF THE BRAYTON CYCLE FOR SPACE APPLICATIONS [THERMODYNAMIQUE DU CYCLE DE BRAYTON POUR APPLICATIONS SPATIALES]
P. Barthelemy, C. Chauvineau, and G. Dieulot Paris, AGARD [1963] 33 p refs In FRENCH
(YCP-471)

An attempt is made to demonstrate the favorable effect that would take place on the thermodynamics of the Brayton cycle used on liquids with solid particles. Three conclusions have been reached: (1) Thermodynamic output is increased when compared with the isothermal process for fluid expansion and compression. (2) The regeneration of heat can be easily accomplished. (3) Heat transfer is improved. The savings of weight are multiple—on the reactor, the turbine, and principally on the condensor. The problem of the compatibility of materials (of turbines in particular) with solid particles merits deeper study. Under certain conditions the gas generator of Brayton cycle would be acceptable. However, for space application the technology of the Rankine cycle generators is more definitive. Trans. by R.E.S.

N65-16322*# Boeing Co., Seattle, Wash.
EVALUATION OF SILVER-CADMIUM BATTERIES Final Report
J. T. Mac Lean and F. S. Kemp [1963] 114 p refs Prepared for Yardney Elec. Corp.
(Contract NAS5-2155)
(NASA-CR-60574; D2-20496-1) OTS: HC $4.00/MF $0.75

This report describes tests conducted on 13-cell batteries of 12-ampere-hour metal-cased silver–cadmium cells. Four of these batteries were cyclically charged and discharged under simulated 300-mile orbital conditions. Discharging 35% of nominal ampere-hour capacity per cycle and operating in radiation heat sinks at −10°, +20°, and +40°C, first cell failures occurred at 313 to 1350 cycles. Two batteries of 12-amp-hr epoxy-potted cells subsequently manufactured were placed on test under the same conditions. A 12-cell battery is still operating normally in a 20° C radiation heat sink after over 3000 cycles. However, a charger malfunction caused failure of a 3-cell battery at 2371 cycles. It was concluded that the short cycle life of the batteries of metal-cased cells was due to unfavorable changes made in the cell construction, not to the larger capacity, the use of more cells per battery, or the use of radiation heat sinks. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-15445 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE INFLUENCE OF PROLONGED WEIGHTLESSNESS ON THE AUTOMATISM OF CARDIAC MUSCLE
R. M. Bayevskiy and K. I. Zhukov *In its* Cosmic Res. 13 Jan. 1965 p 199–204 refs (See N65-15432 06-30)

It is established by statistical analysis of the dynamic interval series of the RR-electrocardiogram that there are characteristic changes in the automatism function of cardiac muscle under the conditions of weightlessness. These changes are associated with an amplification of tonus of the vagus nerve, which is one of the links in the process by which the circulatory apparatus adapts to the new conditions. Thus, instability of the cardiac rhythm in orbital flight is one of the regular physiological reactions to weightlessness. Author

N65-15446 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMBINED EFFECT OF LOW-FREQUENCY VIBRATION AND X-RAYS ON MAMMALIAN BONE-MARROW CELLS
Yu. S. Demin *In its* Cosmic Res. 13 Jan. 1965 p 205–216 refs (See N65-15432 06-30)

The frequency of abnormal mitoses in the bone marrow of mice, following vertical vibration at a frequency of 70 cycles, X-irradiation with a dose of 50 R, and the combined effects of vibration and irradiation, was made the object of study. In the

animals, vibration causes an increase in the frequency of abnormal mitoses, chiefly as a result of increased incidence of chromosome adhesion. Vibration, when administered before irradiation, does not increase the frequency of abnormal mitoses as compared with the abnormality frequency when radiation is used alone. There are, however, differences in the spectrum of the abnormal mitoses—a slight decrease in the frequency of chromosomal rearrangements and an increase in the frequency of adhesions as a result of the combined disturbance. Author

N65-15538# Academy of Sciences (USSR), Moscow.
ON THE BIOLOGICAL ROLE OF GRAVITY (SOME RESULTS AND PROSPECTS OF SPACE RESEARCH ON SATELLITES AND SPACESHIPS)
O. G. Gazenko and A. A. Gurjian [1964] 27 p refs Presented at the COSPAR 7th Plenary meeting and 5th Inter. Space Sci. Symp., Florence, May 1964

Reviewed are the effects of gravity on biological and physiological processes, especially those of weightlessness, as studied in space flights. The effects of prolonged exposure to accelerations upon the development of organisms are also discussed. Definite changes in organisms are observed under conditions of weightlessness and prolonged acceleration. R.E.S.

N65-15558# Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
EFFECTS OF POSITIVE G ON CHIMPANZEES IMMERSED IN WATER
Kenneth R. Coburn, P. H. Craig, and E. L. Beckman 17 Sep. 1964 41 p refs
(NADC-MA-6139; AD-453263)

A concept for the prevention of the deleterious effects of high accelerative forces upon animals by submersing them in water in a constant volume G capsule was proposed. A series of experiments were carried out to evaluate the accuracy of this concept by subjecting primates to accelerations of up to $+31G_z$ in such a constant volume system. The pathological and physiological findings of these experiments demonstrated that mediastinal emphysema and air embolism were produced in all animals by overpressurization of the lungs in the constant volume G capsule either during the acceleration period, or by pressurization of the lungs prior to centrifugation, or by both mechanisms. In addition, circulatory failure occurred at the higher magnitudes of acceleration. Author

N65-15577 Defence Research Board, Ottawa (Canada). Directorate of Scientific Information Services
ON THE STATE OF THE CARDIOVASCULAR SYSTEM UNDER CONDITIONS OF EXPOSURE TO CONTINUOUS NOISE
N. N. Shatalov, A. O. Saitanov, and K. V. Glotova Sep. 1964 5 p refs Transl. into ENGLISH from Higiena Tr. i Professional'-nyye Zabolevaniya (Moscow), no. 6, 1962 p 7, 10–14
(T-411-R; AD-607703)

In persons exposed to the effect of continuous industrial medium-frequency and high-frequency noise of intensity 85 to 120 dB, functional disturbances of the cardiovascular system were frequently observed. Very often, the subjects exhibited an instability of the arterial blood pressure. The electrocardiographic data showed bradycardia with a tendency to retardation of the intravesicular conductivity, plus a depression of the T-wave that was most frequently observed after physical stress and at the end of the work period. In a group of workers subjected to noise of high intensity, functional changes in the cardiovascular system were encountered more often and were more strongly expressed. The above deviations seem due to disturbance of neuroreflex regulation developing under the influence of noise. Author

N65-15594*# Webb Associates, Yellow Springs, Ohio.
BIOASTRONAUTICS DATA BOOK
Paul Webb, ed. Washington, NASA, 1964 404 p refs Sponsored by NASA
(NASA-SP-3006) GPO: HC $2.25; OTS: MF $2.00

A revised summary of quantitative and qualitative human data is presented to fullfill the basic design requirements for the bioastronautical engineer. Considered are: *Toxicology, Atmosphere and Pressure, Temperature, Breathing, Acceleration, Size and Motion, Food, Human Operator, Radiation, Vestibular System, Weightlessness, Impact and Vibration, Energy, Combined Stresses, Water, Waste, Vision, Hearing,* and *Units and Conversions.* G.G.

N65-15627# Argonne Cancer Research Hospital, Chicago, Ill.
SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION
Leon O. Jacobson and Margot Doyle ed. Sep. 1964 170 p refs
(Contract AT(11-1)-69)
(ACRH-22) OTS: $5.00

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2. THE SITES OF MAGNESIUM ABSORPTION AND EXCRETION IN THE INTESTINAL TRACT OF THE RAT p 20–28 refs

3. *IN VITRO* STUDIES ON THE EFFECT OF ERYTHROPOIETIN ON GLUCOSE AMINE-1-C^{14} INCORPORATION INTO RAT BONE MARROW CELLS P. P. Dukes, F. Takaku, and E. Goldwasser p 29–38 refs

4. *IN VITRO* STUDIES OF CELL TYPES RESPONSIVE TO ERYTHROPOIETIN F. Takaku, P. P. Dukes, and E. Goldwasser p 39–44 refs

5. HEMOGLOBIN SYNTHESIS IN MARROW CELL CULTURE: THE EFFECT OF RAT PLASMA ON RAT CELLS O. Gallien-Lartigue and E. Goldwasser p 45–47 refs

6. THE ERYTHROPOIETIC EFFECT OF TESTOSTERONE IN THE POLYCYTHEMIC MOUSE W. Fried, R. De Gowin, and C. W. Gurney p 48–52 refs

7. H^3-THYMIDINE UPTAKE BY A RING X-CHROMOSOME IN A HUMAN FEMALE J. Rowley, S. Muldal, J. Lindsten, and C. W. Gilbert p 53–61 refs

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11. BIOLOGIC PROPERTIES OF POLYNUCLEOTIDES. III: THE ANTICOMPLEMENTARY PROPERTIES OF POLYRIBOGUANYLIC ACID S. Yachnin p 98–100 refs

12. BIOLOGIC PROPERTIES OF POLYNUCLEOTIDES. IV: STUDIES ON THE MECHANISM OF COMPLEMENT INHIBITION BY POLYINOSINIC ACID TOGETHER WITH OBSERVATIONS ON THE *IN VIVO* EFFECT OF POLYINOSINIC ACID ON COMPLEMENT ACTIVITY S. Yachnin and D. Rosenblum p 101–113 refs

13. THE SYNTHESIS OF 4', 5'-DIIODO-4-AMINO-FLUORESCEIN IODINE-131 A. J. Verbiscar p 114–118 refs

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N65-15634# Atomic Energy of Canada Ltd., Chalk River, Ontario.

PHYSIOLOGICAL PROBLEMS OF PLASTIC PROTECTIVE CLOTHING

J. R. Brown (Toronto U.) Nov. 1964 30 p refs

(AECL-2123) Available from Atomic Energy of Canada, Chalk River: $1.00

A study was carried out on the physiological stresses imposed by the wearing of impermeable clothing and the effect of ventilating such clothing. Under conditions of a hot thermal environment, the heat stress to the wearer imposed by impermeable clothing was greatly reduced by ventilation. The value of the "vortex tube cooler" was examined, and it proved to be satisfactory in the four tests carried out. Author

N65-15666# Joint Publications Research Service, Washington, D.C.

RESEARCH ON BIOCHEMISTRY AND IMMUNOLOGY

29 Dec. 1964 93 p refs Transl. into ENGLISH from Usp. Sovrem. Biol. (Moscow), v. 58, no. 2, Sep.–Oct. 1964 p 177–200, 242–252, 262–271, 307–320

(JPRS-28016; TT-65-30005) OTS: $3.00

CONTENTS:

1. CHEMICAL AND MACROMOLECULAR STRUCTURE AND BIOLOGICAL FUNCTIONS OF "SOLUBLE" RIBONUCLEIC ACIDS L. L. Kiselev p 1–33 refs

2. IMMUNOCHEMICAL PROBLEMS IN GENERAL IMMUNOBIOLOGY G. S. Gostev p 34–49 refs

3. CURRENT TRENDS IN RADIATION IMMUNOLOGY R. V. Petrov p 50–63 refs (See N65-15667 06-04)

4. THE FIRST ALL-UNION BIOCHEMICAL CONGRESS AND THE PROBLEMS IN PRESENT-DAY BIOCHEMISTRY R. A. Zarembskiy and I. I. Ivanov p 64–90

N65-15667 Joint Publications Research Service, Washington, D.C.

CURRENT TRENDS IN RADIATION IMMUNOLOGY

R. V. Petrov *In its* Res. on Biochem. and Immunol. 29 Dec. 1964 p 50–63 refs (See N65-15666 06-04) OTS: $3.00

Trends in Russian immunological research are noted, especially in regard to radiation immunology. Techniques of various research groups are discussed, including the use of cell cultures in vivo, the study of radiation chimeras (action of the graft against the host), the study of ways to influence the fate of the cellular graft, and the use of radiobiology to clarify the principles of immunology. D.E.W.

N65-15676# Joint Publications Research Service, Washington, D.C.

RADIATION EFFECTS ON PLANTS AND GRAVITY EFFECTS ON THE ANIMAL ORGANISM

22 Jan. 1965 52 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 6, Nov.–Dec. 1964 p 827–860, 913–915

(JPRS-28405; TT-65-30180) OTS: $3.00

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1. CYTOPHYSIOLOGICAL AND BIOCHEMICAL INVESTIGATIONS OF MICROORGANISMS DURING THEIR RESTORATION FOLLOWING RADIATION INJURY M. N. Meysel et al p 1–32 refs (See N65-15677 06-04)

2. METHODS OF QUANTITATIVE ANALYSIS OF CHANGES ARISING AFTER EXPOSURE TO IONIZING RADIATION G. N. Shangin-Berezovskiy p 33–43 refs (See N65-15678 06-04)

3. EFFECTS OF GRAVITATION IN THE FORMATION OF FUNCTIONS OF THE ORGANISM P. K. Isakov, Ye. M. Yuganov, and I. I. Kas'yan p 44–49 refs (See N65-15679 06-04)

N65-15677 Joint Publications Research Service, Washington, D.C.

CYTOPHYSIOLOGICAL AND BIOCHEMICAL INVESTIGATIONS OF MICROORGANISMS DURING THEIR RESTORATION FOLLOWING RADIATION INJURY

M. N. Meysel, et al *In its* Radiation Effects on Plants and Gravity Effects on the Animal Organism 22 Jan. 1965 p 1–32 refs (See N65-15676 06-04) OTS: $3.00

An extensive and detailed review is given of previous work on the effects of ionizing radiation on living organisms, and the techniques of counteracting these effects. Cultures of different yeast organisms, representatives of the genera *Saccharomyces, Saccharomycodes, Schizosaccharomyces, Endomyces, Candida,* and *Torulopsis,* were grown on malt-agar. Two-day-old cultures were used to prepare yeast suspensions in sterile tap water, which were then irradiated with X-rays. Irradiated and control yeast suspensions were diluted with sterile tap water, transferred to vials, and incubated at 28° to 30° C in a thermostat for several days. Daily inoculations were made from these suspensions, incubated in water, onto Petri dishes of malt-agar medium, for a count of cells capable of unlimited reproduction. Cytological, physiological, and biochemical investigations are described. It was concluded that irradiation-initiated processes of injury and of restoration are intimately related to cellular metabolism. D.E.W.

N65-15678 Joint Publications Research Service, Washington, D.C.

METHODS OF QUANTITATIVE ANALYSIS OF CHANGES ARISING AFTER EXPOSURE TO IONIZING RADIATION

G. N. Shangin-Berezovskiy *In its* Radiation Effects on Plants and Gravity Effects on the Animal Organism 22 Jan. 1965 p 33–43 refs (See N65-15676 06-04) OTS: $3.00

It was concluded that estimation of the rate of the mutation process, either from the percentage of altered plants or from the percentage of families involved in variability, can be replaced by a general evaluation of the variability level that encompasses both the emergence of mutations and their manifestation in the population. A formula is suggested for the calculation of variability that involves the percentage of altered plants, the number of families containing mutants, and the number of types of variability of a certain character observed in the experiment. D.E.W.

N65-15679 Joint Publications Research Service, Washington, D.C.

EFFECTS OF GRAVITATION IN THE FORMATION OF FUNCTIONS OF THE ORGANISM

P. K. Isakov, Ye. M. Yuganov, and I. I. Kas'yan *In its* Radiation Effects on Plants and Gravity Effects on the Animal Organism 22 Jan. 1965 p 44–49 refs (See N65-15676 06-04) OTS: $3.00

Previously published experimental data are reviewed and analyzed. It is concluded that the physiological equivalence of

changes in body weight and altered gravitation (from the terrestrial value) was substantiated. One of the first responses of the organism to weight change is the readjustment of muscle tone in order to retain the original position of the body parts. This response was confirmed by studies on the bioelectrical activity of muscles, gas exchange, and venous pressure. D.E.W.

N65-15710# Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
THE NATURE OF RADIATION FROM NUCLEAR WEAPONS IN RELATION TO FLASHBLINDNESS
J. H. Hill and Gloria T. Chisum 17 Aug. 1964 20 p refs (NADC-ML-6412; AD-453622)

The minimum information about a weapon flash necessary for research and development purposes in regard to the problem of flashblindness is luminance, duration, and visual angle subtended by the source, whether it is a fireball or a surface illuminated by the fireball. The estimation of these parameters is discussed. Author

N65-15719# Joint Publications Research Service, Washington, D.C.
ARTICLES FROM THE 1964 USSR MEDICAL ENCYCLOPEDIA
27 Oct. 1964 205 p refs Transl. into ENGLISH from Bol'shaya Med. Entsiklopediya (Moscow), v. 35, 1964 Columns 162–175, 261–275, 277–301
(JPRS-27112; TT-64-51368) OTS: $6.00

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N65-15720 Joint Publications Research Service, Washington, D.C.
ELECTROMYOGRAPHY
In its Articles from the 1964 USSR Med. Encyclopedia 27 Oct. 1964 p 1–13 refs (See N65-15719 06-04) OTS: $6.00

The electromyograph used to record the electrical responses of skeletal muscles consists of an amplifier and recording element. The ac-operated amplifier has a wide range, low noise, and, with the use of needle electrodes, a high input resistance. The chief methods of recording include the use of skin and needle electrodes. The recording is made on paper or film by means of a cathode or loop oscillograph. Electromyography is particularly valuable for patients with slight motor disturbances because it detects the disturbance in the electrical muscle activity before the clinical signs of pathology appear. An accumulation of factual data permits the recognition of the basic types of normal and pathological electric muscle activity. The use of electromyography is an aid in diagnosing, in determining the localization and severity of injury to the nervous system and muscles, and in furnishing objective documentation of the course of pathological and rehabilitational processes. G.G.

N65-15721 Joint Publications Research Service, Washington, D.C.
ELECTRONARCOSIS
In its Articles from the 1964 USSR Med. Encyclopedia 27 Oct. 1964 p 14–15 refs (See N65-15719 06-04) OTS: $6.00

Electronarcosis is a state of general immobility and absence of defense reactions to pain stimuli and is induced in animals and man by the action of electric currents on the central nervous system. The extensiveness of the symptoms depends on the strength of the applied electric current. Electronarcosis is produced by the action of an intermittent galvanic pulse current or an alternating sinusoidal current with bitemporal, fronto-occipital or fronto-sacral positioning of the electrodes. The applied power has to exceed the production threshold of electronarcosis but must not be so high as to produce electroconvulsive seizures. The mechanism of electronarcosis is associated with the parabiotic inhibition of the cerebral cortex, mainly in the motor–sensory zone. G.G.

N65-15722 Joint Publications Research Service, Washington, D.C.
ELECTROPHORESIS
In its Articles from the 1964 USSR Med. Encyclopedia 27 Oct. 1964 p 16–36 refs (See N65-15719 06-04) OTS: $6.00

Electrophoresis is an electrokinetic phenomenon of displacement in an electric field of particles or coarse suspensions, or of colloid particles and micromolecules suspended in liquid. The displacement of one phase in relation to the other under the influence of an external electrical field is only possible when both phases are oppositely charged. The electrostatic interaction in the liquid phase around the charged particles leads to a diffuse accumulation of ions of the opposite charge, and a double electric layer arises. The differences in electrophoretic mobility lead to the utilization of zone electrophoresis in porous media that are saturated with a buffer solution. This method is used in electrophoresis of blocks, on columns, in flow-through devices and on paper strips. Short summaries are given on electrophoresis in physiotherapy; electrodermal tests; electrophoretic local anesthesia; and electrophoretic examinations. G.G.

N65-15723 Joint Publications Research Service, Washington, D.C.
ELECTROENCEPHALOGRAPH
In its Articles from the 1964 USSR Med. Encyclopedia 27 Oct. 1964 p 37–41 refs (See N65-15719 06-04) OTS: $6.00

The electroencephalograph records the electric activity of the brain through the external or imbedded application of electrodes to different regions of the brain. It consists of an input

device with a commutator; preamplifiers; output amplifiers; recording devices; a power pack; and a calibrator. The frequency characteristics of the various electrical brain impulses are transferred by an ink tracer onto a readout tape. The characteristics of each component are described. G.G.

N65-15724 Joint Publications Research Service, Washington, D.C.
ELECTROENCEPHALOGRAPHY
In its Articles from the 1964 USSR Med. Encyclopedia 27 Oct. 1964 p 42–65 refs (See N65-15719 06-04) OTS: $6.00

Electroencephalography is used to record the electrical potentials that appear in the nerve cells of the brain during their activity. This study discusses the following: history, a survey of electroencephalographic methods, general EEG characteristics, the mechanisms of production of electric activity in the brain, higher nervous activities, electroencephalography in cases of exposure to radiation and in the clinical practice of neurology and psychiatry, and electroencephalography in children. G.G.

N65-15725 Joint Publications Research Service, Washington, D.C.
ELECTROENCEPHALOSCOPE
In its Articles from the 1964 USSR Med. Encyclopedia 27 Oct. 1964 p 66–69 refs (See N65-15719 06-04) OTS: $6.00

The electroencephaloscope permits the simultaneous examination of electric activity in many points of the central nervous system. The spatial distribution of the electrical activity of the brain is transmitted onto the screen of an electron beam tube by modulation of the brightness of the ray, and the quantitative values of all recorded activities are shown concurrently in the form of columns. Tracings of the electrical activities are usually made from 16 to 25 leads and are fed through an amplifier to an oscillograph cathode. The combination of electroencephaloscopy with electronic computer techniques leads to new electrophysiological observations of the normal and pathological conditions in the nervous system of man. G.G.

N65-15790*# Federation of American Societies for Experimental Biology, Washington, D.C.
BIOLOGY DATA BOOK
Philip L. Altman and Dorothy S. Dittmer ed. Wright-Patterson AFB, Ohio, AMRL, Oct. 1964 653 p Supersedes WADC-TR-56-273, AD-110501
(Contract AF 33(657)-10802; Grants NIH GM-06533; AD-GN-255)
(AMRL-TR-64-100; WADC-TR-56-273; AD-110501; AD-454590)

This publication was compiled to present numerical data of biology and medicine in a convenient and accessible form for reference, and to standardize accepted constants as a basis for correlation, to establish common standards for statistical studies, and to provide normal values for research. The biology data are organized in the form of tables, diagrams, charts, and graphs, arranged under the following headings: *Genetics and Cytology, Reproduction, Development and Growth, Morphology, Nutrition and Digestion, Metabolism, Respiration and Circulation, Blood, Biological Regulators and Toxins, Biophysical and Biochemical Characteristics, Environment and Survival, Parasitism,* and *Materials and Methods.* Seven appendixes provide information concerning estimated number of species, taxonomic classification for living plants and animals, geologic distribution, atomic weights, as well as logarithms and antilogarithms. A detailed index completes the book. Author

N65-15801*# Maryland U., College Park.
A STUDY OF PHYCOPHYSIOLOGY IN CONTROLLED ENVIRONMENTS Ninth Semiannual Status Report, 1 Apr.–30 Sep. 1964
Robert W. Krauss 1 Oct. 1964 206 p refs *Its* Tech. Rept.-1009
(Grant NsG-70-60)
(NASA-CR-60396) OTS: HC $6.00/MF $1.25

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2. VAN SLYKE'S BUFFER VALUES FOR CELL SECRETIONS C. Sorokin 17 p refs (See N65-15803 06-04)
3. COMPARATIVE STUDIES OF STEROLS IN CHLORELLA G. W. Patterson 53 p refs (See N65-15804 06-04)
4. A PHYSIOLOGICAL EXAMINATION AND TAXONOMIC REVISION OF SPECIES OF CHLORELLA ISOLATED FROM MARINE HABITATS R. E. Gross 98 p refs (See N65-15805 06-04)

N65-15802 Maryland U., College Park. Agricultural Experiment Station
PHOTOSYNTHESIS IN CELL DEVELOPMENT
Constantine Sorokin *In its* A Study of Phycophysiol. in Controlled Environments 1 Oct. 1964 26 p refs (See N65-15801 06-04) OTS: HC $6.00/MF $1.25

Nonsynchronized suspensions of the green, high-temperature alga Chlorella 7-11-05 were subjected to fractional centrifugation, and two size groups of cells were separated. The small-cell fraction was presumed to consist largely of younger cells and the large-cell fraction predominantly of older cells. Manometric measurements in phosphate buffer at pH 4.5, in bicarbonate buffer at neutral pH, and in carbonate–bicarbonate buffer at pH 9.3 indicated that younger cells invariably possessed higher photosynthetic activity than older cells, provided the separation of cells into size fractions was reasonably good and the large cells were prevented from dividing during the process of separation. The superior activity of younger cells was ascertained at various light intensities and at different temperatures. Author

N65-15803 Maryland U., College Park.
VAN SLYKE'S BUFFER VALUES FOR CELL SECRETIONS
Constantine Sorokin *In its* A Study of Phycophysiol. in Controlled Environments 1 Oct. 1964 17 p refs (See N65-15801 06-04) OTS: HC $6.00/MF $1.25

Van Slyke's buffer indexes (β) were determined for secretions of synchronized cells of the green, high-temperature alga, Chlorella 7-11-05. The change in pH and the value of the buffer index were found to depend on initial pH, duration of observation, and population density. The major component of the secreted buffer system was identified as bicarbonate, and the major cation, as potassium. Author

N65-15804 Maryland U., College Park.
COMPARATIVE STUDIES OF STEROLS IN *CHLORELLA*
Glen W. Patterson (Ph.D. Thesis) *In its* A study of Phycophysiol. in Controlled Environments 1 Oct. 1964 53 p refs (See N65-15801 06-04) OTS: HC $6.00/MF $1.25

The characteristics of the sterols naturally occurring in six species of *Chlorella* were examined. The algae were grown heterotrophically on glucose. Sterols were extracted and isolated from the lipid fraction, and were characterized by means of chemical and physical tests. *Chlorella vannielii, C. nocturna,* and *C. sorokiniana* were found to contain ergosterol as their

principal sterol and 25% as much of another sterol identified as 22-dihydroergosterol. *Chlorella ellipsoidea* and *C. saccharophila* contained a sterol mixture similar to that of higher plants; and poriferasterol was the principal sterol. Gas chromatographic data indicated that the sterols of *C. protothecoides* differed from the others, but their characterization was not achieved. In an attempt to determine the role of these sterols, cells of *C. sorokiniana* were grown autotrophically in the presence of triparanol concentrations that were strongly inhibitory to growth. D.S.G.

N65-15805* Maryland U., College Park.
A PHYSIOLOGICAL EXAMINATION AND TAXONOMIC REVISION OF SPECIES OF *CHLORELLA* ISOLATED FROM MARINE HABITATS
Rudolph E. Gross (M.S. Thesis) *In its* A Study of Phycophysiol. in Controlled Environments 1 Oct. 1964 98 p refs (See N65-15801 06-04) OTS: HC $6.00/MF $1.25

One hundred samples of sea water and brackish water were collected from widely separated areas of the Atlantic and Pacific coasts and examined for species of the genus *Chlorella*. Twenty-nine unialgal isolates were freed from contaminants by standard bacteriological techniques. Included in this study were four previously isolated salt water species from Europe. A series of physiological tests were applied to determine relationships between the different isolates. The tests included growth on selected sugars in the light and darkness, determination of the ability to use NO_3, NH_3 or casein hydrolysate as nitrogen sources, the toxicity or suitability of acetate as a carbon source, and the identification of vitamin requirements. The effects of enriched natural sea water on growth rates were studied employing a group of fresh water species for comparison. Author

N65-15860# Hanford Atomic Products Operation, Richland, Wash. Biology Lab.
PROGRESS IN BIOLOGICAL RESEARCH: A SUMMARY OF HANFORD LABORATORIES ACHIEVEMENTS IN THESE PROGRAMS UNDER GENERAL ELECTRIC, 1956–1964
H. A. Kornberg Nov. 1964 44 p
(Contract AT(45-1)-1350)
(HW-83613) OTS: $2.00

The following subjects were studied: *Metabolism and Toxicity Studies in Small and Large Animals, Metabolism and Toxicity of Inhaled Radionuclides, Molecular and Cellular Level Studies, Studies with Aquatic Organisms, Ecological Studies, Analytical and Pathological Services,* and *Educational and Training Activities.* G.G.

N65-15865# Atomic Energy Commission, New York, N.Y. Environmental Studies Div.
FALLOUT PROGRAM Quarterly Summary Report, Sep. 1–Dec. 1, 1964
Edward P. Hardy, Jr. and Joseph Rivera 1 Jan. 1965 316 p refs (HASL-155) OTS: $4.00

This report presents current data from the HASL Fallout Program, the New Zealand Department of Scientific and Industrial Research, the National Radiation Laboratory in New Zealand, Argonne National Laboratory, and Service de Protection, C.C.R. EURATOM, Ispra, Italy. Radionuclide levels in fallout, milk, tap water, and upper air samples are given in tabular form. Also included are interpretive reports and notes dealing with estimated 1964 Sr-90 deposition in New York City, effect of precipitation on Sr-90 deposition, use of limited number of soil sites for estimating worldwide deposition, measurements of Na-22 in fallout, herbage, and milk, effect of wheat stripping on radionuclide levels in flour and Pu-238 measurements in air at high altitude. A bibliography of recent literature pertinent to fallout studies is given. Author

N65-15867# Joint Publications Research Service, Washington, D.C.
SOME RESULTS AND PROBLEMS OF OBSERVATION UNDER SPACE FLIGHT CONDITIONS
M. M. Kasenkov and A. P. Kuz'minov 5 Feb. 1965 6 p Transl. into ENGLISH of the monograph "O Nekotorykh Rezul'tatakh i Problemakh Nablyudeniya v Usloviyakh Kosmicheskogo Poleta" Moscow, 1964 p 3–6
(JPRS-28646; TT-65-30282) OTS: $1.00

Soviet specialists in engineering psychology and medical ophthalmology used the launchings of the spaceships Vostok and Voskhod to investigate the condition of the visual analyzer in space flight under various unfavorable circumstances. The spectral sensitivity of the eye under conditions of weightlessness was close to the values measured on earth. Up to accelerations of about 2 g's, the drop in the sharpness of vision was insignificant. At greater accelerations, there was a deterioration in vision sharpness and a reduction of the angle of the visual field. Sharpness of vision was rapidly restored in orbit. Visual observation from space of different earth formations was possible for objects having an angular size on the order of 20 to 15 feet. To study the vestibular organ and central nervous system, a written electro-oculargram was made of the motor activity of the eye. Optimum lighting conditions in the ship's cabin were also considered. R.L.K.

N65-15872# Joint Publications Research Service, Washington, D.C.
STUDIES IN THE BIOCHEMISTRY AND CHEMOTHERAPY OF NERVOUS AND PSYCHIC DISEASES
28 Jan. 1965 200 p refs Transl. into ENGLISH from Zh. Vses. Khim. Obshch. (Moscow), v. 9, no. 4, 1964 p 374–380, 395–443, 448–455
(JPRS-28527; TT-65-30226) OTS: $6.00

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2. CONTEMPORARY PRESENTATIONS ABOUT THE BIOCHEMISTRY OF PHYSIOLOGICALLY IMPORTANT DERIVATIVES OF INDOLE N.N. Suvorov p 20–48 refs

3. ABOUT THE NATURE, THE MECHANISM OF ACTION, AND THE SPECIFIC INHIBITION OF MITOCHONDRIAL MONOAMINOOXIDASES V. Z. Gorkin p 47–66 refs

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N65-15963# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ACTIVITY OF CYTOCHROMEOXIDASE IN BODILY ORGANS OF RATS ADAPTED TO HIGHER AND LOWER TEMPERATURES

L. Janskiy 1 Dec. 1964 4 p ref Transl. into ENGLISH from Cesk. Fysiol. (Prague), v. 11, 1962 p 447–448
(FTD-TT-64-444/1+2; AD-454385)

Experiments conducted revealed that adaptation to cold not only influenced the relative cytochromeoxidase activity, but also increased the weight of livers, hearts, lungs, and kidneys, while the weight of skin and muscles dropped. The influence of high temperatures in general activity compared with that of cold; however, the organs in vivo showed values about 100% higher. The conclusion reached is that adaptation to much higher temperatures led to the development of a mechanism making total utilization of the metabolic capacity of the tissue impossible. R.E.S.

N65-16027*# Naval School of Aviation Medicine, Pensacola, Fla.

VESTIBULAR PROBLEMS IN RELATION TO SPACE TRAVEL

Ashton Graybiel [1964] 26 p refs Presented at the Intern. Vestibular Symp., Philadelphia, 10–12 Sep. 1964
(NASA Order R-93)
(NASA-CR-60419) OTS: HC $2.00/MF $0.50

Current knowledge concerning the effects of high G loading, weightlessness, and artificial gravity on the semicircular canals and otolithic organs is reviewed. Additional studies needed in these areas are pointed out. Investigations are described in which subjects were exposed briefly in a rotating environment (slow rotation room) to estimate their susceptibility to illusions and canal sickness, and, for a more prolonged period of exposure, to study summation and adaption effects. In the first category, normal persons experienced definite symptoms of canal sickness at some velocity between 5 and 20 rpm. Subjects with varying degrees of loss of function of the sensory organs of the inner ear did not experience such symptoms. Animal experiments indicated that unilateral destruction of the labyrinth abolishes canal sickness only temporarily, but that occluding two ducts bilaterally abolishes all sickness permanently. Under longer exposure, the higher the rpm, the more severe were the symptoms and the slower was the adaptation. R.L.K.

N65-16028*# Allied Research Associates, Inc., Concord, Mass.

REVIEW OF BIOLOGICAL MECHANISMS FOR APPLICATION TO INSTRUMENT DESIGN Third Quarterly Report

Janet Healer 9 Dec. 1964 4 p
(Contract NASw-535)
(NASA-CR-60434; ARA-211-3) OTS: HC $1.00/MF $0.50

The clarification of the mechanisms responsible for the electric field sensitivity of biological organisms could have application to a number of detection systems, such as the underwater detection devices which could detect missile-carrying nuclear submarines. It was found that electric currents are directed to certain areas of plant surfaces. Some animal organisms were found to migrate toward certain electrically charged areas. Chemoreceptor responses in insects and other arthropods were studied, and it was found that the role of olfactory responses involving odor memory and spontaneous responses to odor would be valuable in a sophisticated navigational system. Photoreceptors in the plant and animal kingdoms play a significant role in the orientation of growth or locomotion. Many aquatic animals showed some activity response to the increase or decrease of light at extremely low intensities. A comparative investigation of vertebrate otoliths was reviewed. R.E.S.

N65-16136# Joint Publications Research Service, Washington, D.C.

EFFECT OF OXYGEN STARVATION AND ACCELERATION ON THE CONTENT OF GLUTAMIC AND GAMMA-AMINOBUTYRIC ACIDS IN BRAIN TISSUE

Ye. D. Avenirova, B. M. Savin, and I. A. Sytinskiy 3 Feb. 1965 10 p refs Transl. into ENGLISH from Vopr. Med. Khim. (Moscow), v. 10, no. 6, Nov./Dec. 1964 p 595–600
(JPRS-28630; TT-65-30276) OTS: $1.00

The object of the experiment was to establish the similarities and differences in the variation of the glutamic and gamma-aminobutyric acid (GABA) contents in brain tissue under the influence of overloads or oxygen starvation. The results of the experiments indicated that: (1) In acute oxygen starvation (corresponding to a stay at an altitude of 5000 to 10000 meters for 1 min) the content of GABA in the rat cerebrum increased by 30%, and in the cerebellum by 40% in comparison with the norm. In cases of acute hypoxia, a great increase in the amount of GABA was noted. (2) In the case of overloads in the head-pelvic and pelvic-head directions at values of 18 g for 1 min, the GABA content remained within normal limits. (3) Various changes in the GABA content in the brain tissue under the influence of overloads and phenomena of acute oxygen starvation showed evidence of a difference in the factors leading to the change in the amount of this substance. R.E.S.

N65-16161# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine

THE EFFECT OF PHYSICAL CONDITIONING OF AN INDIVIDUAL BEFORE AND AFTER SUFFERING A MYOCARDIAL INFARCTION

John Naughton, Bruno Balke, and Francis Nagle Jan. 1964 12 p refs
(Grant PHS HE-06286-03)
(AM-64-2)

Personnel engaged in aviation activities are not exempted from the development of coronary heart disease. A 54-year-old white male suffered an acute inferoseptal myocardial infarction after he had voluntarily taken part in a regular exercise program designed to improve the conditions of existing hypertension, overweight, and hypercholesterolemia. The postinfarct recuperation was uncomplicated. Four weeks later, physical activities were slowly increased from day to day. A remarkable progress in restoring cardiorespiratory efficiency was observed when the training was switched from dull types of exercises to simply competitive ball games. The training response was similar to that observed in normal individuals. Twenty and twenty-three weeks postinfarct, this individual was normotensive, had a normal serum cholesterol concentration, and a near-normal body weight. In addition, his capacity for making cardiorespiratory adjustments to high metabolic demands exceeded the originally established level. Author

N65-16185# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine

THE SIZE CUE TO VISUALLY PERCEIVED DISTANCE

Walter C. Gogel Jan. 1964 27 p refs
(AM-64-13)

Evidence indicates that both perceived size S' and retinal size θ are involved in both the relative and familiar size cue to relative depth. There is also evidence to indicate that the familiar size cue cannot be subsumed under the relative size cue. But both types of size cues can be included under the concept of perceived size per unit of retinal size (S'/θ). It is asserted that the perceived depth between objects, as determined by the size cue, is a function of the value of S'/θ associated with each of the objects. Evidence relevant to specifying the relation between values of S'/θ and perceived depth is evaluated with respect to methodological problems involved in the use of comparison fields. Author

N65-16207# Joint Publications Research Service, Washington, D.C.
INVESTIGATIONS IN INDUSTRIAL HYGIENE AND OCCUPATIONAL PATHOLOGY [ISSLEDOVANIYA PO GIGIYENE TRUDA I PROFESSIONAL'NOY PATOLOGII]
Ye. Te. Andreyeva-Galanina 11 Feb. 1965 145 p refs Transl. into ENGLISH from the Trans. of the Leningrad Sanit.-Hyg. Med. Inst. (Leningrad), v. 75, 1963 p 7-56, 62-68, 74-90, 94, 101-118, 132-143, 231-251
(JPRS-28721; TT-65-30312) OTS: $4.00

Papers are presented on a variety of subjects related to vibration sickness, the effects of local and total vibration on different animal and human subjects, the vibration damage to tissues as an occupational hazard, the use of vibration absorbers to protect workers, and the toxicology of various freon gases. D.E.W.

N65-16215# Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
THE GRADATIONAL STEP TEST FOR ASSESSING CARDIORESPIRATORY CAPACITY: AN EXPERIMENTAL EVALUATION OF TREADMILL AND STEP TEST PROCEDURES
Francis Nagle and Bruno Balke Jan. 1964 14 p refs
(AM-64-3)

A suitable stepping device and a feasible testing procedure evolved for the assessment of functional adaptive capacity. This test provides for minute-by-minute increments of energy expenditure in multiples of the basal metabolic rate (Mets), ranging from 2.5 to 15 Mets within a 25-minute period in tests with normal individuals. A modified test (slower stepping rate and different step increments) is suggested for the evaluation of patients or other individuals with severely reduced work capacity. In this test the energy demands progress from 2.5 to 9 Mets within a 20 to 22-minute period. Author

N65-16216# Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
DESIGN AND PERFORMANCE CHARACTERISTICS OF A MECHANICALLY DRIVEN VESTIBULAR STIMULATOR
William E. Collins and Harlie W. Huffman Oct. 1964 11 p
(AM-64-15)

A mechanical-drive angular acceleration device was designed and constructed for use as a vestibular stimulator. Calibration data obtained with a tachgenerator, an angular accelerometer, and an electronic counter indicate that accelerations at all rates below 25°/sec^2 and to all terminal velocities less than 25 rpm are linear, and that maximum trial-to-trial variability between 0.25°/sec^2 and 20°/sec^2 does not exceed $\pm$0.02°/sec^2 or $\pm$1.0% of the acceleration rate, whichever is larger. Thus, the stimulator may be used for a large number of vestibular experiments where rates of acceleration and terminal velocities are not required to exceed 20°/sec^2 and 25 rpm, respectively. Author

N65-16276*# Resources Research, Inc., Washington, D.C.
RADIOISOTOPIC BIOCHEMICAL PROBE FOR EXTRATERRESTRIAL LIFE Quarterly Progress Report No. 11
Gilbert V. Levin et al 15 Jan. 1964 58 p
(Contract NASr-10)
(NASA-CR-55529) OTS: HC $3.00/MF $0.50

Four remote field tests, conducted at sites selected for adverse environmental conditions, were successful in detecting life within very short time periods. The sites tested were: Orange, Virginia, which provided a hard, clay soil of high iron content at the surface; Sheep Mountain in White Mountains, California, which provided an altitude of 12 200 feet, an area above the tree line, and extremely rocky terrain; Death Valley, California, which provided an arid, sandy region; and the Salton Sea area of the Imperial Valley, also in California. This last site provided a surface soil that was hard, rocky, and of high salt content. In spite of some minor operational and mechanical problems, metabolic responses were positive, rapid, and distinct. Studies were also conducted to enhance the growth of pure culture and mixed populations from soils. R.T.K.

N65-16278*# Stanford U., Calif.
THE FLUOROMETRIC ASSAY OF SOIL ENZYMES
Lawrence Hochstein Jan. 1962 41 p
(Grant NsG-81-60)
(NASA-CR-50919) OTS: HC $2.00/MF $0.50

Fluorometric assays of phosphatase and leucyl aminopeptidase (peptidase) are described. In general, the enzymic activities were detectable after short incubation times and required relatively small quantities of soil. The assays are complicated by the native fluorescence of soil, by an apparent quenching of fluorescence by soil in the phosphatase assay, and by the association of enzymic activity with soil particles. A total of 59 soil samples was screened for phosphatase activity. There seem to be two kinds of phosphatase activity in soil, one that exhibits maximum activity in an alkaline environment and one that is more active in an acidic environment. The presence of soil aminopeptidases was assayed using L-leucyl-β-naphthyl-amide as the substrate. Thirty-five soils were surveyed for peptidase activity. Results are presented in tables and graphs. D.E.W.

N65-16287# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE STAND OF MUDR. J. STEPANEK IN THE DISCUSSION ABOUT NATURAL AND SOCIAL ASPECTS IN HUMAN PSYCHOLOGY
J. Beranek and V. Tlusty 5 Dec. 1964 8 p Transl. into ENGLISH from Cesk. Psychiat. (Czechoslovakia), v. 59, no. 1, 1963 p 66-68
(FTD-TT-64-65/1; AD-451788)

A detailed rebuttal is presented to discredit the comment of Stepanek on a paper by Monert that had been given at a conference held at the Faculty of General Medicine in Prague. The argument stems from an identification of human psychology with physiological processes, i.e., the assumption that psychic laws are independent of social conditions. D.E.W.

N65-16291# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ADAPTATION OF PHYSIOLOGICAL HOMOISOTHERM PROPERTIES TO COLD
L. Jansky 8 Dec. 1964 44 p refs Transl. into ENGLISH from Cesk. Fysiologie (Czechoslovakia) v. 12, no. 2, 1963 p 105-125 Presented at the Seminar of Physiolog. Inst. of Czech. Acad. of Sci., Liblice, 10 Oct. 1962
(FTD-TT-64-445/1+2; AD-455488)

Acclimation and acclimatization changes were investigated in order to define clearly the changes that occur in an organism

under the effect of artificial and natural cold stimuli. Male rats were acclimated to cold temperatures (+6° C) and were then studied for acclimation mechanisms and cold resistance. Cold adaptation was found to be primarily a metabolic adaptation, coupled with the gradual development of a new chemical thermoregulation component that promotes heat generation in the muscles. An extensive discussion of shivering and non-shivering thermogenesis is given. Other discussions are given of changes in weight, in physiological properties of the circulatory system, in hormones, and hormone production, in tissue metabolism, and in peripheral zones directly exposed to the cold, and of pathological changes after exposure to cold. Acclimation and its relation to acclimation changes are briefly treated, and a few experiments studying cold adaptation in human beings are reported. D.E.W.

N65-16299# School of Aerospace Medicine, Brooks AFB, Tex. Environmental Systems Dept.

BACTERIOLOGIC POTABILITY OF CONDENSATE WATER FROM HEAT EXCHANGERS OF PRESSURE SUITS

James E. Moyer and Y. Z. Lewis Nov. 1964 10 p refs

(SAM-TDR-64-66; AD-455390)

The possibility of utilizing water condensates recovered from the heat exchangers of pressure suits as an emergency source of drinking water was investigated. Five-hour condensate samples were collected and subjected to quantitative and qualitative bacteriologic analysis. Results indicate that condensate water may serve as an emergency source of potable water provided it is consumed within a short period of time after collection. Storage of the condensates results in a water of an unacceptable bacteriologic purity for imbibition purposes. Author

N65-16303*# National Aeronautics and Space Administration, Washington, D.C.

BIO-LIKE STRUCTURES [BIOPODOBNYYE STRUKTURY]

V. O. Kalinenko Jan. 1965 12 p Transl. into ENGLISH from Nauka i Zhizn' (Moscow), no. 8, 1963 p 67–70

(NASA-TT-F-9244) OTS: HC $1.00/MF $0.50

This article deals with the origin and creation of primary organisms. It describes the natural method of the formation of cells. Experiments carried out by Russian scientists are explained, in which electrical currents are used to create living organisms. A process referred to as energobiosis is described. Photographs are given showing the various stages of development of these organisms. Author

N65-16304*# National Aeronautics and Space Administration, Washington, D.C.

HYDREMIA AND HYDREMIC EDEMA [UEBER HYDRAMIE UND HYDRAMISCHES OEDEM]

J. Cohnheim and L. Lichtheim Feb. 1965 49 p refs Transl. into ENGLISH from Arch. Pathol. Anat. Physiol. (Berlin), v. 69, 1877 p 106–143

(NASA-TT-F-9247) OTS: HC $2.00/MF $0.50

Experiments were made by injecting large amounts of salt solution into the jugular vein of dogs and rabbits without damaging the red corpuscles. No trace of skin edema was found. Changes in the bloodstream velocity of frogs, dogs, and rabbits were determined from observations of the mesenterium, the tongue, and the skin under the microscope. Hydremic plethora leads to a considerable increase in the transudation into the tissue of many organs. The organs found to be edemic were not those observed in this state in hydropic kidney patients. A new interpretation of hydrops in kidney patients is attempted. Author

N65-16319*# Florida State U., Tallahassee. Inst. for Space Biosciences

THE CATALYTIC DECOMPOSITION OF GLUCOSE IN AQUEOUS SOLUTION BY THERMAL PROTENOIDS

Sidney W. Fox and Gottfried Krampitz [1964] 14 p refs Submitted for Publication

(Grant NsG-173-62)

(NASA-CR-60569) OTS: HC $1.00/MF $0.50

The catalytic activity reported is related to the decomposition of uniformly labelled C^{14}–glucose to $C^{14}O_2$ at a low rate of conversion. Experimental evidence indicates that at least a small fraction of the glucose is first converted to glucuronic acid, which is then decarboxylated, and that each of these two reactions is catalyzed in aqueous solution by proteinoid prepared by thermal condensation of dry amino acids mixed in appropriate proportions. D.E.W.

N65-16326*# Stanford U., Calif. Medical School

MEMBRANE SEPARATION

Jerry Lundstrom May 1963 34 p refs

(Grant NsG-81-60)

(NASA-CR-51103) OTS: HC $2.00/MF $0.50

Methods of determining the permeability coefficient in gas-membrane-gas systems from the permeability curves are reviewed; these curves show the accumulated moles of solute in the downstream chamber as a function of time. As a result of a literature search for permeability coefficient values for CO_2 and conversion of these values to common units of cm^2/sec, a table comparing the permeability of the following membranes is presented: silicone rubber, polyvinyl chloride with 20 parts of di(2-ethyl hexyl) phthlate plasticizer, natural rubber, Teflon, polyethylene, and porous glass. Preliminary results of dye permeability studies are presented in which silicone rubber, Teflon, and polyethylene were measured for their permeability to disodium fluorescein. Experiments involving disodium fluorescein and disodium eosin permeabilities to cellophane are also reported. An approximation is made of the separation that a silicone rubber membrane would provide in a life-detection device using the permeability data for carbon dioxide and for disodium fluorescein as a crude approximation to the permeability of organic metabolites. D.S.G.

N65-16328*# Stanford U., Calif. Instrumentation Research Lab.

CYTOCHEMICAL STUDIES OF PLANETARY MICROORGANISMS—EXPLORATIONS IN EXOBIOLOGY Status Report, Mar. 1, 1962–Apr. 1, 1963

Joshua Lederberg and Elliott Levinthal [1963] 63 p refs

(Grant NsG-81-60)

(NASA-CR-51096) OTS: HC $3.00/MF $0.75

Exobiological and related cytochemical discussions are presented as follows: (1) the general problem of the quest for signs of life; (2) the multivator—an attempt to generalize the instrumental requirements of exobiological experiments; (3) assays being developed for inclusion in the multivator—hydrolytic assays and techniques of membrane separation to measure the production of molecules with membrane transmission properties differing widely from those of the substrate; (4) the application of video-scanning techniques to biological problems; (5) the exploitation of the possibilities of computer technology as applied to the problems of exobiology. Also presented is a list of papers and seminars presented by members of the Instrumentation Research Laboratory. I.v.L

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-15537# Rocketdyne, Canoga Park, Calif.
SOURCES OF INFORMATION IN HUMAN FACTORS ENGINEERING, INCLUDING ASSOCIATED AREAS IN SYSTEM SAFETY, MAINTAINABILITY, PERSONNEL SUBSYSTEM, LIFE SCIENCES, QUALITY ASSURANCE, AND RELIABILITY ENGINEERING
George A. Peters and Frank S. Hall 1 Jan. 1965 168 p refs
(RH-3398-H)

The 380 reference sources listed include bibliographies, directories, abstract services, journals and textbooks of technical information in the field of human factors engineering. There are 371 regulatory and guidance documents referred to, including various regulations, specifications, standards, manuals, instructions, and program requirements that attempt to define the character of the contractor's human factors functions. Ninety descriptive publications are a sampling of government agency reports that attempt to describe how various functions might be accomplished, review the state-of-the-art in a given area, present new methods, or list basic data which might be useful in human factors analyses. Sixty-five illustrative reports are a cross section of contractually required or data submittal reports that are representative of what was actually accomplished, how it was done, and the type of organization or approach that was utilized. R.L.K.

N65-15546*# Lafayette Clinic, Detroit, Mich.
DEVELOPMENT OF A SELECTION TEST FOR MOTIVATIONAL APTITUDE
A. F. Ax, P. G. S. Beckett, N. A. Fretz, and J. S. Gottlieb Washington, NASA, Jan. 1965 49 p refs
(Contract NAS2-1031)
(NASA-CR-156) OTS: HC $2.00/MF $0.50

Described is the development of a test for motivational aptitude. It is based on the hypothesis that the aptitude for acquiring the social motives ranges widely, from the lowest in the schizophrenia and the hobo types, to the highest in the most productive people. The procedure used was the acquisition of a conditioned (learned) response of the automatic nervous system, namely, the classical conditioning of the palmar sweating response (GSR). It was concluded that Physiologic Learning Aptitude (PLA), which is believed to be a measure of the ability to acquire the secondary or social motives, can be measured by this conditioning procedure. With further documentation and streamlining, this procedure should have a valuable application for the selection of highly adaptable persons who can be readily trained or conditioned for high-stress tasks, such as space flight. Author

N65-15580# Martin Co., Baltimore, Md.
ORBITAL SPACE STATION STUDY. VOLUME III: TEST OPERATIONS PLAN. APPENDIX I, PART B: EXPERIMENT DEFINITIONS FOR BIOASTRONAUTIC TESTS
[1964] 291 p
(Contract AF 04(695)-561)
(SSD-TDR-64-213, V. 3, App. I-B; AD-448396)

A complete summary of the various tests to be used for the bioastronautical orbital evaluation of man is presented. Each test is described and analyzed for its importance, operational factors, manning operations, data and communications requirements, logistics, support equipment requirements, and its procedure and sequence. G.G.

N65-15598# California U., Los Angeles. Biotechnology Lab.
UPPER EXTREMITY PROSTHETICS RESEARCH. HUMAN TRACKING. SENSORY MOTOR CONTROL Progress Report, Jun. 15–Dec. 15, 1964
John Lyman 15 Dec. 1964 30 p ref
(Contracts N123(60530)-32857A; V1005p-9779; Grant VRA-RD-1201M-64)
(Rept.-64-58)

A performance study of the Heidelberg pneumatic prosthesis indicated that, while useful, it involved less accurate, slower performance with more errors than a conventional prosthesis, and required more maintenance. A custom-made pneumatic arm is being evaluated. Functional muscle isolation and breathing control investigations were carried out to facilitate abdominal and pectoralis control of arm prostheses. An externally powered electronic hand, applying automatic control theory, is being developed and evaluated; it relieves the amputee of some of the decisions necessary for voluntary guidance of control motions. For the tracking simulator, a method of generating trajectories was devised which allows position, velocity, and acceleration in azimuth and elevation each to be electrically programed. A program for reducing the analog tapes produced by the Sampled Error Scoring System was completed. A two-part experiment related to problems of initial target acquisition and reacquisition was designed to determine the capabilities and limitations of human predictive processes in tracking, and to assess the utility of various modes of target acquisition. R.L.K.

N65-15615*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRAINING FOR A FLOATING-POINT DISPLAY OF NUMBERS
Robert J. Randle, Jr. and Clayton R. Coler Washington, NASA, Feb. 1964 18 p refs
(NASA-TN-D-2634) OTS: HC $1.00/MF $0.50

An automatic typewriter was programed for use in evaluating the response of subjects to floating- and fixed-point numbers. The task of receiving and returning numbers to a digital computer was simulated, i.e., the subjects typed a fixed-point number on the machine or converted it to a floating-point number before typing it. Output was the reverse operation, i.e., the floating-point form was converted to fixed-point, and fixed-point remained in fixed-point form. The results indicated that, under the conditions of the experiment, the high initial error rates in converting numbers decreased with training and became comparable to those made in simply repeating the fixed-point numbers. It was concluded that intensive training of inexperienced subjects on this task element is advantageous. The design of displays for digital computers which read out in floating-point form may not seriously affect performance if the subject is trained specifically for the task. The computer itself may be programed to provide the initial practice and subsequent refresher exercises. Author

N65-15664# Chicago U., Ill. Committee on Mathematical Biology
AN INTRODUCTION TO THE THEORY OF ADAPTIVE PATTERN RECOGNITION
Hugo M. Martinez 1 Oct. 1964 66 p refs
(Contract AT(11-1)-614; Grant AF-AFOSR-370-63)
(AD-608157)

An introduction to the theory of adaptive pattern recognition is presented, having a scope intended to serve as a bridge between the general type of survey and the specialized works. Little or no experience of the field is assumed. There are three sections. The first is devoted to the concepts of

adaptive system, pattern and pattern recognition, with due attention to establishing a relevant framework and terminology. The next section discusses in detail some of the analytical problems inherent to the generic pattern recognition devices known as adalines, perceptrons, matched filters, and stochastic classifiers. The final section gives a brief resume of the notion of separability and of the establishment of certain conditions for its attainment by means of linear and quadratic discriminant functions. Author

N65-15709# Winzen Research, Inc., Minneapolis, Minn.
REPORT ON LOW LEVEL BALLOON PILOT TRAINING AND QUALIFICATION FLIGHTS
J. R. Nelson 14 Feb. 1964 49 p
(Contract N123(61756)32762A(PMR))
(Rept.-1282-R; AD-430755)

A series of low-level balloon pilot training flights were conducted. Balloons, associated flight equipment, and flight operation services were supplied. The objective of the program was to qualify and obtain FAA licenses for Navy personnel as free balloon pilots. Three flights were conducted using the Skycar II, and one operation using one-man jump balloon harness and seat. The qualification and licensing of three pilots were completed. Author

N65-15728# Human Factors Research, Inc., Los Angeles, Calif.
A STUDY TO DETERMINE THE EFFECTS OF PLACEBOS UPON PERFORMANCE IN A VIGILANCE TASK
J. O'Hanlon, Jr., E. A. Schmidt, and C. H. Baker Jan. 1964 23 p refs
(Contract Nonr-4120(00))
(TR-750-3; AD-428565)

An experiment was undertaken to determine the effects of ingested placebos upon signal detection performance in a vigilance task. The observers were given to understand that the placebos (pills) had certain specific, though alleged, effects upon human alertness. One placebo, colored white, was alleged to contain chemicals which affected performance in an unknown manner. Another placebo, colored orange, was alleged to make people more alert. A third placebo, yellow, was alleged to make people less alert. Eighty observers undertook a conventional vigilance task, 20 assigned to each condition of white pill, orange pill, and yellow pill; and 20 performed the task without a pill. There were no differences in detection performance among the four conditions. It was concluded that in a conventional vigilance task, the ingestion of placebos which observers believe to be drugs having definite positive, negative, or unknown effects upon signal detection performance does not affect performance. Author

N65-15738# George Washington U., Washington, D.C. Human Resources Research Office.
ARMY AVIATION HUMAN RESEARCH UNIT QUARTERLY PROGRESS REPORT, APRIL–JUNE 1964
30 Jun. 1964 18 p refs
(Contract DA-44-188-ARO-2)

Work is reported on the improvement of aerial gunnery training in the armed helicopter, the improvement of navigation training for low-level flight, synthetic flight training programs and devices, the design of rotary wing training devices considering aircraft characteristics and task difficulty, the improvement of methods of training aerial surveillance personnel, and integrated contact–instrument training. D.E.W.

N65-15779# Michigan U., Ann Arbor. Mental Health Research Inst.
STUDIES IN BEHAVIORAL ASPECTS OF GRAMMAR AND SEMANTICS Final Report
John L. Mc Namara Griffiss AFB, N.Y., RADC, Oct. 1964 206 p refs
(Contract AF 30(602)-3042)
(RADC-TDR-64-146; AD-609807)

Investigations were made of natural and simulated language behavior. The first investigation concerned the question of how syntactic language behavior is related, if at all, to modern theories of grammar. In order to develop a mechanical syntactic analyzer to replace an ordinary literate reader of a text, it is necessary to understand how the latter comprehends a text. In other words, a syntactic analyzer should be modeled on principles similar to those used by a human reader. The second investigation covered a number of approaches to the study of a "semantic space." These experiments are essentially word association experiments, in which the controls are stricter than free association experiments, but not as strict as in Osgood's semantic differential techniques. Author

N65-15788# North American Aviation, Inc., Los Angeles, Calif.
MOMENTS OF INERTIA AND CENTERS OF GRAVITY OF THE LIVING HUMAN BODY ENCUMBERED BY A FULL-PRESSURE SUIT Final Report, Jul.–Dec. 1963
J. Du Bois, W. R. Santschi, D. M. Walton, C. O. Scott, and F. W. Mazy Wright-Patterson AFB, Ohio, AMRL, Nov. 1964 63 p refs
(Contract AF 33(657)-11619)
(NA-64-527; AMRL-TR-64-110; AD-609863)

The center of gravity and the moments of inertia of each of 19 male subjects, representative in stature and weight of the U.S. Air Force population, were determined. Two body positions—sitting and relaxed; and three modes of dress—nude, suited-unpressurized, and suited-pressurized—were investigated. The theoretical accuracy of the experimental procedures, based on a compound pendulum, ranged from 2% to 8%, depending on body position and axis. The moments of inertia were found to vary significantly between body positions and between nude and suited conditions. Correlation coefficients between the moments of inertia and stature and weight exceeded 0.9. Fifty anthropometric dimensions and frontal and profile photographs were obtained on each subject to serve as the basis for additional biodynamic analyses. Author

N65-15959# American Inst. for Research, Palo Alto, Calif.
LEARNING VIA PROGRAMED READING AND CUE VERSUS RESPONSE IN PROGRAMED READING Technical Report Nos. 5, 6
Wayne Hershberger Jul. 1963 61 p refs
(Contract Nonr-3077(00))
(AIR-C28-7/63-TR; AD-415936)

It was found that discursively written texts that were programed to include heterogeneous typography highlighting essential core content, and self-evaluational response items quizzing the reader on the core content, were considerably more effective in teaching the essential material than discursively and tersely written texts incorporating neither program characteristic. A follow-up study was designed to assess the relative effectiveness of typographical cueing versus self-evaluational responding on the learning and retention of essential lesson content in both discursively and tersely written

texts. Results indicated that under no conditions did typographical cueing increase either the efficiency or effectiveness of the texts. On the other hand, irrespective of lesson topic, writing style, typography, or reading ability, self-evaluational responding facilitated both the learning and retention of the content over which the reader was quizzed. R.L.K.

N65-16009# Indiana U., Bloomington.
LINGUISTIC TRANSFORMATIONAL ANALYSIS Final Report, 1 Jan.–31 Dec. 1963
J. P. Thorne and J. Lyons Griffiss AFB, N.Y., RADC, Oct. 1964 125 p
(Contract AF 30(602)-2951)
(RADC-TDR-64-200; AD-608747)

The feasibility and utility of a kernelization procedure for purposes of information retrieval are presented. The leading section discusses the problems involved in the kernelization of complex English sentences. Appendix I contains a detailed report of the kernelization procedure. Appendix II reports on a series of experiments to determine to what extent information was preserved in kernelized versions of sentences. Appendix III reports on a frequency count of the transformations exhibited by a stretch of running text. Appendix IV contains a list of transformational rules that have actually been written, with reference to significant published (and some unpublished) material. Author

N65-16106# Otis Elevator Co., Brooklyn, N. Y. Defense and Industrial Div.
ADAPTIVE TRAINING AND NONVERBAL BEHAVIOR
Edwin M. Hudson Jul. 1964 136 p refs
(Contract N61339-1395)
(NAVTRADEVCEN-1395-1; AD-610572)

Seventy-three male subjects were trained for at least 10 hours each in tasks which varied in either the dynamic nature of the controlled plant or in the level of difficulty during practice. Subjects were tested both during and at the end of practice on four dynamic tracking tasks of widely different levels of difficulty and plant characteristics. The results were that nearly all groups of subjects trained in the adaptive modes displayed greater transfer from practice to the test conditions than did those subjects who practiced only on the test conditions themselves. Author

N65-16173# Ohio State U., Columbus. Aviation Psychology Lab.
EXPERIMENTS ON TEAM TRAINING IN A CIC-TYPE TASK ENVIRONMENT
George E. Briggs and James C. Naylor Jun. 1964 39 p refs
(Contract N61339-1327)
(NAVTRADEVCEN-1327-1; AD-608309)

Three separate but related laboratory experiments were performed with three-man teams in a simulated radar-control interception task. Experiment I investigated the influence of a replacement of one team member with a new operator, the latter having either more or less on-the-job experience than the man replaced. Also investigated was the influence of task organization and task complexity. In Experiment II the influence of training task fidelity, training task organization, and transfer task organization was examined. Finally, Experiment III examined the influence of different amounts of experience on two kinds of training task organization and of transfer task organization. Replacement effects were significant but of short duration, but transfer task organization effects were of longer duration with performance on an independent task organization superior to that on an interaction version except when preceded by individual training and/or training specifically on communication procedures. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-15567 Naval Ordnance Lab., Corona, Calif.
SYNTHETIC STUDIES
D. L. Herring and C. M. Douglas *In its* Foundational Res. Proj. 1 Jun. 1963 p 7–19 refs (See N65-15565 06-34)

A continuing study of the intermediates formed in the reaction of $(C_6H_5)_2PCl_3$ with NH_3 is reported. In $CHCl_3$ solution, the reaction gave a 40% to 65% yield of $[(C_6H_5)_2PNH_2]_2NCl$ plus a 15% to 30% yield of a viscous oil that might have been $[(C_6H_5)_2PNH_2]_2N$. Analytic studies of this reaction and possible reaction routes are described, as well as the details of the experimental procedures. Infrared spectra of various compounds are given. D.E.W.

N65-15568 Naval Ordnance Lab., Corona, Calif.
POLYMERIZATION MECHANISM STUDIES
K. L. Paciorek and R. H. Kratzer *In its* Foundational Res. Proj. 1 Jun. 1963 p 20–31 (See N65-15565 06-34)

The study of the mechanism of phosphonitrile polymer formation via the reaction of organophosphinous halide with a metal azide was continued. To determine the existence of diphenylphosphinous azide, the reaction of diphenylphosphinous chloride with lithium azide in acetonitrile (at ca. −15° C) was reinvestigated. The decomposition of the reaction solution (filtered at ca. −20° C from the lithium salts) afforded 1.09 mole of nitrogen for each mole of phosphorus present in the filtrate. This value indicates that all the phosphorus present prior to the decomposition is in the form of diphenylphosphinous azide or its association product. The analysis of the decomposition products showed the presence of chloride and azide ions. Since the combined molal quantity of these ions is equal to the moles of lithium, it is apparent that they were derived from lithium salts dissoved in the acetonitrile. This evidence confirms the absence of diphenylphosphinous chloride. Author

N65-15571 Naval Ordnance Lab., Corona, Calif.
THE ELECTROREDUCTION OF SUBSTITUTED AROMATIC NITRO COMPOUNDS IN LIQUID AMMONIA SOLUTIONS
W. S. Harris *In its* Foundational Res. Proj. 1 Jun. 1963 p 47–49 (See N65-15565 06-34)

It was found that the low rate reduction of m-dinitrobenzene uses eight electrons in acid solution but only about two electrons in neutral solution. It is suggested that, to improve the weight efficiency of proposed high-power density batteries, materials be sought that can operate in neutral solutions where NH_3 or H_2O can be the source of the hydrogen ions used in the reductions. Preliminary results of an investigation into the effects of ring substituents on the course of electroreduction of aromatic nitro compounds are reported. D.E.W.

N65-15572 Naval Ordnance Lab., Corona, Calif.
IONIC MELT ELECTROCHEMISTRY
R. E. Panzer *In its* Foundational Res. Proj. 1 Jun. 1963 p 50–57 refs (See N65-15565 06-34)

Investigations in ionic melts based on salts or systems melting in the range of 120° to 190° C are reported. Analysis of the first set of factorial-designed cells was completed, and three other sets were set up, run, and analyzed. Results are given from these studies and from the determinations of the specific conductivities of various alkali thiocyanate systems. D.E.W.

N65-15604# Joint Publications Research Service, Washington, D.C.

ORGANO-METALLIC ADDITIVES IN POLYSTYRENE

Ye. Ye. Baroni, S. F. Kilin, T. N. Lebsadze, I. M. Rozman, and V. M. Shoniya 1 Feb. 1965 11 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 17, no. 6, 1964 p 497–500

(JPRS-28565; TT-65-30247) OTS: $1.00

To obtain polystyrenes containing Pb, Bi, Hg, Sn, and Se, the solubility of their phenyl compounds was determined in the monomer. Detailed methods are described for the thermal polymerization of styrene with these compounds. Data are given for polymers with an added quantity of the phenyl compounds equaling 12 wt% Pb, 19 wt% Bi, 33 wt% Hg, 12 wt% As, 11 wt% Sn, and 10 wt% Se. The polymers were obtained as clear, air stable substances. These materials were designed as scintillation detectors for gamma radiation and neutrons. Data are given on the luminescence efficiency of plastic scintillators containing Pb, Hg, and Sn. Author

N65-15621# Bureau of Mines, Reno, Nev. Reno Metallurgy Research Center

CONVERSION TO METAL OF DIMOLYBDENUM CARBIDE ELECTROSYNTHESIZED FROM MOLYBDENITE

H. J. Heinen, C. L. Barber, and Don H. Baker, Jr. 1965 18 p refs

(BM-RI-6590)

A technique offering promise as a metallurgical processing sequence for the recovery of molybdenum (Mo) from the sulfide mineral—molybdenite—was investigated. The method consists of two steps (1) electrosynthesis of pure dimolybdenum carbide (Mo_2C) from molybdenite (MoS_2), and (2) interaction of Mo_2C and molybdic oxide (MoO_3) to produce pure molybdenum metal. Two molten salt systems were satisfactory for electrosynthesizing Mo_2C. The first was a mixture of potassium chloride (KCl), potassium fluoride (KF), and sodium metasilicate (Na_2SiO_3), and the second consisted of sodium fluoride (NaF), KF, sodium tetraborate ($Na_2B_4O_7$), and sodium carbonate (Na_2CO_3). Yields up to 0.42 g of Mo_2C per A-h were obtained. The carbide, mixed with monitored amounts of MoO_3, was converted to molybdenum metal of 99.9% purity by sintering at 1500° C. Author

N65-15638# Carborundum Co., Niagara Falls, N.Y. Research and Development Div.

TOPOTACTICAL REARRANGEMENT IN AlC_4B_{24} AND PREPARATION OF A NEW BORON CARBIDE TYPE STRUCTURE

J. Economy, V. I. Matkovich, and R. F. Giese, Jr. Oct. 1964 12 p refs Presented at the Am. Chem. Soc., Chicago, 1964

(Contract Nonr-4075(00))

(TR-4; AD-608443) OTS: $1.00

Single crystals of AlC_4B_{24} undergo an irreversible rearrangement at high temperatures to a boron carbide type structure. During the reaction, the form of the original single crystal is not altered, which enables tracing of the crystallographic axes during the transition. The rearrangement can be expressed in terms of a change in packing from hexagonal closest to cubic losest packing of icosahedral boron groups. The boron carbide phase contains a variable amount of aluminum over the composition range of $B_{12}C_2Al_{.25} - B_{12}C_2Al_{.75}$. This range is interpreted to be part of a homogeneity range between a boron carbide $B_{12}C_2$ and a ternary phase $B_{12}C_2Al$. Author

N65-15639# California U., Los Angeles.

THE VISCOELASTIC RELAXATION MECHANISMS OF INORGANIC POLYMERS: THE POLYPHOSPHORYLDIMETHYLAMIDES

A. Eisenberg and L. Teter Sep. 1964 22 p refs Presented at the 1964 Meeting of the Soc. of Rheol., Pittsburgh, 26–28 Oct. 1964

(Contract Nonr-233(87))

(TR-5; AD-608331)

The viscoelastic properties of the polyphosphoryldimethylamides were investigated by the technique of stress relaxation as a function of the P to N ratio, and therewith of the chain length. From the great similarity of the shape of the curves to those of "normal" organic polymers, i.e., poly(methyl methacrylate) or polystyrene as a function of the molecular weight, as well as from the difficulty of preparing samples below the gelpoint, it was concluded that the relaxation mechanism in the flow region is molecular flow, with the bond interchange along the backbone either completely absent or present to only a minor extent. Author

N65-15640# Oak Ridge National Lab., Tenn.

ANALYTICAL CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING NOVEMBER 15, 1964

M. T. Kelley and C. D. Susano Jan. 1965 146 p refs

(Contract W-7405-ENG-26)

(ORNL-3750) OTS: $5.00

Analytical chemistry research was conducted with respect to the following areas: instrumentation, molten salt systems, radiation effects, chemistry for reactor projects, advanced reactor fuels, biochemistry, X-ray and spectrochemistry, mass spectrometry, infrared spectroscopy, optical and electron microscopy, nuclear properties and radiochemistry, inorganic and organic preparations. Service analyses reports included those from groups in quality control, mass spectrometry, spectrochemical laboratory, reactor engineering service laboratory, and radiochemical laboratories. M.G.J.

N65-15649# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.

THE USE OF SOFT X-RAYS FOR MATERIALS ANALYSIS: THE L EMISSION SPECTRA OF THE Fe GROUP TRANSITION METALS AND THEIR OXIDES Technical Documentary Report, May 1963–Jun. 1964

David W. Fischer Sep. 1964 56 p refs

(ML-TDR-64-263; AD-608258)

A new analytical technique for determining the oxidation state of crystalline or amorphous oxide films of the first series transition metals was developed. This technique makes use of the soft X-ray L emission spectra of these metals and their oxides. A detailed study was made of the wavelengths, intensities and band shapes and the changes that occur in them when going from pure metal to various states of oxidation. The dependence of the L_{II}/L_{III} intensity ratio on excitation potential, valence state and atomic number is also presented as is the optimum peak to background conditions. Results were obtained using a flat crystal vacuum spectrometer with electron excitation and an ultrathin window flow proportional counter. Crystals used were gypsum, mica, potassium acid phthalate (KAP) and rubidium acid phthalate (RbAP) with $AlK\alpha_{1,2}$ and $AlK\alpha_{3,4}$ satellite doublet from Al_2O_3 as wavelength standard. Author

N65-15668# Joint Publications Research Service, Washington, D.C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 138

19 Jan. 1965 72 p refs Transl. into ENGLISH from Hua-hsueh Tung pao (Peking), no. 7, Jul. 1964 p 11–26, 50–52; no. 9, 14 Sep. 1964 p 61–63; Kuang-ming Jih-pao (Peking), 7 Dec. 1964 p 2

(JPRS-28351; TT-65-30151) OTS: $3.00

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N65-15669 Joint Publications Research Service, Washington, D.C.

CHEMISTRY OF FLUORO-NITROSO-COMPOUNDS AND FLUORO-NITROSO RUBBERS

Hsi-chun Hung *In its* Transl. on Communist China's Sci. and Technol. 19 Jan. 1965 p 1-27 refs (See N65-15668 06-06) OTS: $3.00

The chemical properties and several methods of preparing nitroso-fluorides are discussed, including their preparation from the following sources: fluorine iodides, derivatives of perfluoro carboxylic acids, the addition reaction of perfluoro alkenes, and perfluoro acetone. The mechanism of polymerization and the preparation of elastomers and their properties are also reviewed. R.L.K.

N65-15670 Joint Publications Research Service, Washington, D.C.

RECENT ADVANCES IN THE RESEARCH OF GELATIN

Nai-fu Chow *In its* Transl. on Communist China's Sci. and Technol. 19 Jan. 1965 p 28-44 refs (See N65-15668 06-06) OTS: $3.00

Discussed are the chemical structure and preparation of gelatin, the structure of collagen, the configuration and shape of gelatin molecules in solution, the transformation of physical properties in gelation, the mechanism of gelation, and the structure of gel. The rotatory dispersion method used in protein research is treated briefly. R.L.K.

N65-15671 Joint Publications Research Service, Washington, D.C.

A METHOD OF CONTINUOUS DETERMINATION OF SULFATES AND CHLORIDES IN WATER

Lan-hsing Li and Chia-shen Huang *In its* Transl. on Communist China's Sci. and Technol. 19 Jan. 1965 p 46-55 refs (See N65-15668 06-06) OTS: $3.00

For sulfate determination, the indirect titrametric method is applied, by using $Pb(NO_3)_2$-EDTA as the reagent and dimethyl-phenol orange as the indicator. For chloride determination, a thorium-dimethyl phenol orange colorimetric method is used. Each method, with the equipment, reagents, and results, is discussed. Author

N65-15672 Joint Publications Research Service, Washington, D.C.

METHOD OF DETECTING THE ISOMERS OF CRESOLS AND CHLOROPHENOLS

P'ing-ch'ou Chu *In its* Transl. on Communist China's Sci. and Technol. 19 Jan. 1965 p 56-58 refs (See N65-15668 06-06) OTS: $3.00

The method proposed in this report is to conduct coupling reaction of a definite amount of cresol or chlorophenol mixtures with p-nitrodiazobenzoyl salt under definite conditions. The colored azo compound is dissolved in trichlorqmethane and then chromatographed in a silica gel adsorption column with benzene as the eluant. The existence of isomers is tested by the positions and colors of the colored bands. Author

N65-15673 Joint Publications Research Service, Washington, D.C.

CONSECUTIVE DETERMINATION OF TITANIUM AND IRON

Ta-chung Cheng *In its* Transl. on Communist China's Sci. and Technol. 19 Jan. 1965 p 59-64 refs (See N65-15668 06-06) OTS: $3.00

The combined titanium and iron contents of an ore test liquid are determined by titration with potassium dichromate, after the titanium content is determined by titration with ferrite. The iron content is obtained by deducting the titanium content from the combined contents. This method is suitable for mass production because expensive reagents and special apparatus are not required. R.L.K.

N65-15688# Monsanto Research Corp., Dayton, Ohio.

SOLID REACTANT POLYURETHANE FOAM COMPOUND Technical Documentary Report, 15 Apr. 1963-15 Apr. 1964

John Mann Butler and L. E. Erbaugh Wright-Patterson AFB, Ohio, AF Mater. Lab., Aug. 1964 86 p refs

(Contract AF 33(657)-11285)

(ML-TDR-64-258; AD-609215)

Work was directed toward the development of a one-package composition which, in space environment, on localized thermal initiation, would self-propagate a reaction to give a rigid polyurethane foam. Calculations and calorimetric measurements showed the theoretical possibility of a self-propagating reaction from localized initiation. However, in practice, this goal was not attained. This was probably due to heat-transfer problems and inability to efficiently use all the heat of the liberated reaction. Improved formulations were developed, based on tolidine diisocyanate and polyoxypropylene polyols. These compositions, when thermally initiated under vacuum (2×10^{-5} torr) foam and cure to rigid foams. Initiation temperatures and heat input requirements are less than for previously developed formulations. One-package formulations thermally convertible at atmospheric pressure to polyurethane foams were also developed. Author

N65-15701# Hercules Powder Co., Wilmington, Del. Hercules Research Center

A STUDY OF THE ELECTRONIC CONFIGURATION AND BEHAVIOR OF THE -NF_2 GROUP Seventh Quarterly Report, 1 Sep.-30 Nov. 1964

A. D. Craig 21 Dec. 1964 40 p refs

(Contract DA-31-124-ARO(D)-62; ARPA Order 402)

(HRC-64-5; AD-453451)

Work was performed on the polarographic reduction of NF_3 in aqueous systems, and it was shown that NF_3 gives an irreversible pH-independent wave in neutral and in basic systems. An analysis of the current-voltage curves for NF_3 established a value of αn_a of 0.20 ±0.01, indicating that the rate-controlling step is a one-electron step. The overall reaction appears to be: $NF_3 + 6e^- + 3H^+ \rightarrow NH_3 + 3F^-$. Infrared spectroscopy of solvated HNF_2 complexes at −160° and 25° indicated that association occurs primarily through hydrogen bonding of the difluoramine hydrogen with the solvent. Studies of the interaction of HNF_2 and CH_3NF_2 with some protonic acids disclosed a weak association be-

tween the difluoramines and the acids, but no evidence for protonation of either difluoramine was observed. The electric discharge products of N-F compounds with fluoride acceptors in electrodeless electric discharges were trapped immediately after discharge, and their decompositions were monitored by mass spectrometry. G.G.

N65-15707# Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.
THE ENERGETICS OF MICELLAR SOLUBILIZATION, AN ACTION OF THE DETERGENCY MECHANISM Final Report
A. Mankowich 30 Nov. 1964 21 p refs
(CCL-171; AD-609665)

Micellar solubilization, an action of the detergency mechanism, is considered from the standpoint of quasi-thermodynamics. The basis of the approach was suggested by the similarity of micellar solubilization and Freundlich adsorption isotherms. Free energy change (ΔG), heat of solubilization (ΔH), and change in entropy (ΔS) for the micellar solubilization of Orange OT are calculated using two-phase theory and the Gibbs–Helmholtz equation. It is postulated that the dye concentration in the solution (monomer) phase is that at the critical micelle concentration. The dye concentration in the solubilized phase is computed for the dye-penetrated portion of the micellar volume. Calculated values of ΔG in anionic and nonionic surfactants are of the order of magnitude of a physical adsorption. The positive ΔH values indicate the process is not an adsorption. The positive ΔS values point to increased randomness or possibly to decreased energy effects due to iceberg water molecule structure surrounding the hydrophobic dye molecules. The loss of the water structure around the latter in the solubilization process would result in their acquiring increased configurational entropy. Author

N65-15739# Southampton U. (Gt. Brit.)
ASYMMETRIC ELECTRONIC TRANSITIONS AND PHOTOCHEMISTRY Annual Technical Report, 1 Nov. 1963–31 Oct. 1964
R. C. Cookson [1964] 14 p Incorporates Quart. Tech. Status Rept. No. 4
(Contract DA-91-591-EUC-3142)
(AD-453961)

The investigation covered transitions of sulphur compounds. A range of ethylene dithioketals of optically active ketones were made, and the ultraviolet and circular dichroic absorption was measured. The circular dichroism of diazocamphor and diazoisofenchone is sensitive to variation in composition of solvent and appears due to specific solvation of the diazochromophore. Optically active charge-transfer from a $\beta\alpha$ double bond to the carbonyl group of a lactone was observed in unsaturated lactones similar to transitions from double bonds to carbonyl groups of ketones. The photochemistry of dehydrocamphor and dehydro-epicamphor was studied. The photochemical isomerization of α-hydroxy ketones to lactones was examined by use of deuterium tracers. Author

N65-15771# Queens U., Belfast (Northern Ireland).
STUDIES IN THE THERMOCHEMISTRY OF BORON-CONTAINING MOLECULES Annual Technical Report, Sep. 1, 1963–Aug. 31, 1964
Henry Mackle and Margaret A. Frisch [1963] 48 p refs
(Contract DA-91-591-EUC-3108)
(AD-451478)

An aneroid high precision semimicro reaction calorimeter is described. It may be used to investigate the calorimetry of a wide range of reacting systems including those in which one component is a gas. Its heat capacity is 120 cal deg^{-1} and, in conjunction with the ancillary monitoring equipment, heat outputs of the order of 10 cal may be measured with a precision of $\pm 0.1\%$. Temperature changes are followed using a 75 cps bridge incorporating a novel low noise phase-sensitive null detector and the temperature against time data are automatically recorded on a printout counter. The heats of addition at 25° C of diborane gas to mono-, di-, and tri-phenyl phosphine and tri-p-tolyl phosphine in benzene solution are reported. The theoretical significance of these data is discussed at some length. Author

N65-15781# Barcelona U. (Spain).
A STUDY OF THE SYNTHESIS AND PROPERTIES OF ALKAROMATIC CHLOROCARBONS
Manuel Ballester Wright-Patterson AFB, Ohio, ARL, Sep. 1964 34 p refs
(Contract AF 61(052)-141)
(ARL-64-141; AD-609569)

The preparation and study of 55 new highly chlorinated compounds, including 31 chlorocarbons, 4 perchloroketones, 4 perchloroacids and 4 perchloroesters are reported. The chlorocarbons consist of derivatives of toluene, xylene, styrene, stilbene, p-xylylene, diphenylmethane, biphenyl, anthracene, phenanthren, fluorene, and benzene and biphenyl polymeric chlorocarbons. Author

N65-15844# Atomic Energy Commission, Washington, D.C. Div. of Isotopes Development
ISOTOPE SYSTEMS DEVELOPMENT PROGRAM: Sixth Annual Contractors Meeting
Feb. 1965 73 p Meeting held in Washington, 9–10 Nov. 1964
(CONF-641101) OTS: $3.00

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N65-15848# Olin Mathieson Chemicdl Corp., New Haven, Conn. Chemicals Div.

DEVELOPMENT OF NONFLAMMABLE HYDRAULIC FLUIDS AND LUBRICANTS Final Report, Oct. 1963–Oct. 1964

E. H. Kober, H. F. Lederle, and G. F. Ottmann 17 Nov. 1964 72 p refs

(Contract NObs-90092)

(AD-608144) OTS: $3.00

A large number of trimeric and tetrameric aryl-1,1-di-H-polyfluoroalkyl phosphonitrilates was synthesized and evaluated. Several of these products meet or approach the requirements for pour point, volatility, viscosity, density, spontaneous ignition temperature, and thermal and hydrolytic stability; these compounds also display excellent wear properties. Several trimeric and tetrameric arylamino-polyfluoroalkoxy phosphonitriles were prepared. The properties of a few representatives of this novel class of compounds come close to meeting the requirements for naval hydraulic fluids. Addition of ethylene oxide or glycidol to hydroxy-aryloxy- or amino-aryloxy-phosphonitriles gave water-soluble products that have potential for use in water-base hydraulic fluids. Author

N65-15861# California Inst. of Tech., Pasadena. Chemistry and Chemical Engineering Div.

NITROGEN-15 MAGNETIC RESONANCE SPECTROSCOPY, III

Joseph B. Lambert, Bryan W. Roberts, Gerhard Binsch, and John D. Roberts Sep. 1964 12 p refs Submitted for Publication

(Contract Nonr-220(26); Grant PHS-G-11072-01)

(TR-35; AD-608244)

High-resolution nitrogen −15 n.m.r. spectroscopy was used to obtain information concerning the molecular structure of nitrogen compounds, the electronic structure and hybridization of nitrogen, the mechanism of spin–spin coupling, the site of protonation of nitrogen compounds, the effect of protonation on chemical shifts, and the rates of proton exchange at nitrogen. All studies were performed on isotopically enriched samples, and computer averaging techniques were applied to enhance the signal-to-noise ratios. G.G.

N65-15862# California Inst. of Tech., Pasadena. Chemistry and Chemical Engineering Div.

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY. STUDIES OF 1, 1, 4, 4-TETRAFLUORO-1, 3-ALKADIENES

Kenneth L. Servis and John D. Roberts Sep. 1964 33 p refs Submitted for Publication

(Contract Nonr-220(26))

(TR-34; AD-608243)

The 1, 1, 4, 4-tetrafluoro-1, 3-butadiene is indicated by dipole-moment studies to exist in the *s-trans* conformation. The $^{19}F-^{19}F$ spin–spin couplings constants for this compound are surprisingly similar to those of bis-4, 5-(difluoromethylene)-cyclohexene and perfluoro-1, 2-dimethylenecyclobutane, both of which substances have their double bonds held in *s-cis* configurations. The results are related to the mechanism of transmission of fluorine–fluorine spin–spin interactions and are inconsistent with a predominance of a through-space mechanism of couplings. Author

N65-15864# London U. (Gt. Brit.) Royal Holloway Coll.

[PREPARATION OF DIBORON COMPOUNDS AND SPECTROSCOPIC PROBLEMS INVOLVED IN VARIOUS BARON-CONTAINING MOLECULES] Final Technical Status Report, Oct. 1, 1963–Sep. 30, 1964

Arthur Finch and I. Hyams [1964] 40 p refs

(Contract DA-91-591-EUC-2705)

(AD-451548)

An experiment is described in which tetradimethylamino diboron II is combined with ethylene glycol using CO_2, and

dimethylammonium dimethylcarbamate is prepared from dimethylamino and CO_2. The two resulting compounds were compared, and it was found that although the infrared spectra were identical, the refractive indices were 1.495 and 1.425. Finally, a thin-layer chromatography on alumina was carried out for both compounds, with a reaction product of a spot with the same R_f value as the independent sample on one compound, and another spot identified as $(CH_2)_2(OH)_2$ by comparison of its R_f value with a standard. A discussion of the infrared experiments and a description of the preparation of the diborons are included. Finally, calculations were carried out on the fundamental frequencies of a general dimethylamino group, and the results were used to assign the spectra of dimethylamino group, and the results were used to assign the spectra of dimethylamino and tetrakis (dimethylamino) diboron. All calculations and tabulations are given. R.E.S.

N65-15880# Martin Co., Baltimore, Md. Research Inst. for Advanced Studies .

THEORETICAL AND QUANTUM CHEMISTRY OF N, O, F COMPOUNDS Quarterly Technical Report, 9 Oct. 1964–9 Jan. 1965

Joyce J. Kaufman [1965] 15 p refs
(Contract DA-31-124(ARO)-D-203; ARPA Order 542)
(QTR-3; AD-455389)

An investigation of the theoretical and quantum chemistry of energetic N, O, and F compounds, to provide understanding of the fundamental bonding and behavior of these species, is reported. The results of a variety of semiempirical LCAO-MO calculations, using NF_2 as a test case, appear to indicate that extensive refinement of the simple extended Hückel method is probably unwarranted. Rigorous LCAO-MO-SCF calculations on NF, using a gaussian basis set of 5 s-type and 6 p-type orbitals on each atom, provided satisfactory molecular orbitals, from which various properties of this species may be derived. Various modifications of two iterative procedures that are based upon the dependence of the diagonal elements of the Hamiltonian on charge were programed, and none was found to be convergent. The open-shell POLYATOM program was modified to suppress the oscillations and to reach convergence. A semiempirical LCAO-MO-SCF method, including electron repulsion for three-dimensional closed-shell molecular calculations, was derived and is described. D.E.W.

N65-15888*# National Aeronautics and Space Administration, Washington, D.C.

DETERMINATION OF THE REACTION RATE CONSTANT OF ATOMIC OXYGEN WITH METHANE [OPREDELENIYE KONSTANTY SKOROSTI REAKTSII ATOMARNOGO KISLORODA S METANOM]

V. V. Azatyan, A. B. Nalbandyan and Meng-yuan Ts'ui Feb. 1965 20 p refs Transl. into ENGLISH from Kinetika i Kataliz (USSR), v. 5, no. 2, Mar.–Apr. 1964 p 201–210
(NASA-TT-F-9246)

By measuring the first limits of ignition of stoichiometric mixtures of H_2 with O_2 and CO with O_2 containing various small amounts of methane in the range of 570° to 660°, the rate constant of the reaction $O + CH_4 = OH + CH_3$ was found to be $(0.94 \pm 0.4)\ 10^{-10}\ e - (8700 \pm 800)/RT)\ cm^3\ mol^{-1}\ sec^{-1}$. The value of the rate constant of the reaction $H + CH_4 = H_2CH_3$ at 610° was found to be equal to $4.9 \cdot 10^{-14}\ cm^3\ mol^{-1}\ sec^{-1}$. The mathematical expressions obtained from the adopted mechanism are in quantitative agreement with the experimental data. Author

N65-15903# Bureau of Mines, Salt Lake City, Utah. Salt Lake City Metallurgy Research Center

REDUCTION OF SEEPAGE LOSSES FROM CANALS BY CHEMICAL SEALANTS. I: LABORATORY RESEARCH ON SODIUM CARBONATE AND OTHER COMPOUNDS

W. W. Agey and B. F. Andrew 1965 38 p refs
(BM-RI-6584)

An inexpensive technique that laboratory studies indicated would significantly reduce seepage in irrigation canals was devised and tested. Laboratory tests simulating optimum field conditions determined that easily applied sodium carbonate solutions made test beds of canal lining materials virtually impermeable for long periods. The study comprised alternative laboratory treatments of 3-in.-deep test beds of canal earths with 74 water-soluble chemicals in search of one or more that would effectively improve the water barrier characteristics of the component clays. Sodium carbonate, one of the least expensive, was among the most effective. The addition of 0.4 lb of reagent per sq yd greatly reduced the seepage from typical, highly permeable test beds. The reagent penetrated and sealed the surface for about a 1.5-in. depth. Author

N65-15919*# Stanford Research Inst., Menlo Park, Calif.

STUDY OF GROWTH PARAMETERS FOR REFRACTORY CARBIDE SINGLE CRYSTALS Quarterly Status Report No. 3, 1 Sep.–1 Dec. 1964

F. A. Halden and H. J. Eding 29 Jan. 1965 31 p refs
(Contract NASr-49(19); SRI Proj. PMU-4892)
(NASA-CR-60437) OTS: HC $2.00/MF $0.50

A theoretical analysis of high-temperature behavior of carbides during fusion crystal growth indicated that it should be possible to maintain single-phase compositions at the melting point. Polished sections and X-ray lattice constant measurements confirmed that, under suitable conditions, carbides can be arc melted without significant shifts in stoichiometry. It appeared that control of the composition of the gaseous environment may permit significant variations in carbide stoichiometry within the single-phase region. Melting of the carbides in the rf plasma was not attained. Initial carbon solubility runs were completed on germanium, germanium-10 atomic% hafnium, aluminum-10 atomic% hafnium, and iron-10 atomic% hafnium alloys. As a result of these runs, germanium was eliminated from consideration because it was not possible to separate the carbide crystals from the solvent at the completion of a run. Carbon solubilities in the aluminum–hafnium alloy appeared very close to those for silicon, which is employed for the growth of silicon carbide crystals. R.L.K.

N65-15941# California Inst. of Tech., Pasadena. Div. of Chemistry and Chemical Engineering

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY. TEMPERATURE DEPENDENCE OF THE SPECTRUM OF FLUOROCYCLOOCTATETRAENE

Donald E. Gwynn, George M. Whitesides, and John D. Roberts Nov. 1964 10 p refs Submitted for Publication
(Contract Nonr-220(26))
(TR-36; AD-608245)

The fluorine n.m.r. spectrum of fluorocyclooctatetraene was shown to be temperature dependent between 30° and −65°. This is attributed to changes in the rate of an inversion-bond shift process, which is slow on the n.m.r. time scale at low temperatures. The free energy of activation for inversion is approximately 12 kcal/mole at −33° Author

N65-15952# London U. (Gt. Brit.) Royal Holloway Coll.
VERY LOW-FREQUENCY INFRA-RED SPECTROSCOPY Annual Technical Status Report No. 3, Oct. 1, 1963–Oct. 1, 1964
Arthur Finch and D. Steele [1964] 7 p refs
(Contract N62558-3030)
(AD-608145)

Improvements in instrumentation included the redesign of the drive system for the chopper unit, and the design of a 1 1/2-meter gas cell. Previous investigations of the infrared spectra were extended to the far infrared (650-110 cm^{-1}). Results on sulfur dicyanide, azulene, boron tribromide, boron triiodide, and compounds containing the B–B bond are reported. A series of cyclic organo–tin–sulfur compounds were investigated, and the observed spectral frequencies are presented in tabular form. D.S.G.

N65-15976# Rock Island Arsenal Lab., Ill.
EMULSION COPOLYMERIZATION OF SILICON DIHYDRIDES AND DIACETYLENIC HYDROCARBONS
R. R. Freeman and E. I. Spearman 13 Oct. 1964 18 p refs
(Rept.-64-2899; AD-452946) OTS: $0.50

Results are presented on the emulsion copolymerization of silicon dihydrides and diacetylenic hydrocarbons, using chloroplatinic acid and related catalysts. The highest molecular weight copolymers (η_{inh}=0.66) synthesized were based on chloroplatinic acid catalyzed methylphenylsilane and 1,6 heptadiyne. These polymers were tacky, elastic gums that crosslinked readily upon storage at room temperature. It was found that refluxing the polymers in a benzene solution of an epoxy compound minimized premature crosslinking. No change was noted in the tackiness of the polymers. The type of emulsifier (anionic, cationic, nonionic) used in the polymerization had a considerable effect on the final molecular weight of chloroplatinic acid catalyzed methylphenylsilane-1,6 heptadiyne polymers. Recipes containing anionic soaps were found to give polymers of the highest molecular weight. However, this observation did not hold true for other catalysts or other monomer combinations. In an effort to obtain silcarbane elastomers having improved thermal stability, the unsaturated methylphenylsilane-1,6 heptadiyne rubbers were hydrogenated. Unfortunately, the hydrogenated polymers were nonrubbery solids. Author

N65-15984# Union Carbide Research Inst., Tarrytown, N.Y.
RESEARCH ON PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH TEMPERATURE MATERIALS FOR ROCKET NOZZLES Quarterly Progress Report, 1 Oct.–31 Dec. 1964
Richard W. Kebler 31 Dec. 1964 59 p refs
(Contract DA-30-069-ORD-2787; ARPA Order 34-63)
(AD-609974)

The high-temperature chemical and physical behavior of tungsten, graphite, and the refractory carbides and borides of the transition metals were studied with regard to their future application as rocket materials. The following subjects were investigated: *Gas–Solid Reactions*—the oxidation kinetics of W by CO_2, the W-HF reaction, an analysis of stagnation-flow reactors, a rocket-nozzle-insert test and analysis program, and mass-spectrometric studies; *Physical and Mechanical Properties*—high-temperature X-ray studies, elastic properties, the high-temperature creep of refractory carbides, and the steady-state creep in body-centered-cubic metals; *Specimen Preparation and Characterization*—purification and sample preparation, and analytical research; and *Composites*—preparation and mechanical properties. G.G.

N65-16025# Akron U., Ohio. Inst. of Rubber Research
LOW TEMPERATURE POLYMERIZATION STUDIES Progress Report, Oct. 1–Dec. 31, 1964
Maurice Morton 12 Jan. 1965 14 p refs
(Contract AF 04(611)-9694)
(PR-4; AD-610038)

The polymerization of various monomers by gamma radiation at reduced temperatures was studied. The presence of small amounts of acetonitrile led to a considerable acceleration in the polymerization rate of acrylonitrile. Vinyl fluoride polymerized at −74° C, but the action was accompanied by gas evolution and deterioration of the originally white polymer. Vinyl chloride polymerized readily at −74° C but some evolution of HCl took place. Allyl cyanide yielded only a small amount of oily substance when exposed to 50 megarads of radiation at −74° C. Purified chloral yielded about 3% conversion to an insoluble polymer when exposed to 45 megarads of radiation at −55° C. Hexafluoroacetone did not polymerize under similar conditions. G.G.

N65-16063# Tracerlab Inc., Waltham, Mass.
THE ION EXCHANGE PROPERTIES OF CERIUM (IV) COMPOUNDS Final Report
Gregory G. Rocco 1 Nov. 1964 50 p refs
(Contract AF 19(628)-3844)
(AFCRL-64-907; AD-610108)

The ion exchange properties of ceric phosphate were investigated, including rates of reaction, distribution coefficients of alkali metals, capacity, and column behavior of some elements. Ceric oxide was shown to possess anion exchange properties in acid solution and cation exchange properties in basic solution. The two compounds have properties analogous to, but not identical with, zirconium oxide and phosphate. Cesium and barium were successfully separated on a short column of ceric phosphate at room temperature. Author

N65-16087# Princeton U., N.J. Frick Chemical Lab.
KINETICS OF THE THERMAL DISSOCIATION OF N_2F_4 IN SHOCK WAVES
A. P. Modica and D. F. Hornig 31 Oct. 1963 51 p refs
(Contract Nonr-1858(26))
(TR-4; AD-425108)

The equilibrium dissociation of $N_2F_4 \rightarrow 2NF_2$ was studied in shock waves, yielding an equilibrium constant identical to those obtained previously in static measurements. The thermal dissociation rate for N_2F_4 diluted with argon, helium and SF_6 was studied between 350° and 450° K at total pressures of 0.58 to 2.7 atm. The reaction

$$M + N_2F_4 \xrightarrow{k_M} M + 2\,NF_2$$

was found to be first order in M and first order in N_2F_4, indicating the bimolecular mechanism. The rate constant for argon can be expressed either by

$$k_A = 1.5 \times 10^{12} T^{1/2} \exp(-15{,}200/RT) \text{ liter/mole sec.}$$

or

$$k_A = 3.0 \times 10^{8} T^{1/2} (E_o/RT)^{4.0} \exp(-E_o/RT) \text{ liter/mole sec.}$$

where E_o is the dissociation energy of N_2F_4, here taken to be 18.4 k. cal/mole. For the other gases the activation energy was unchanged, the relative rate constants being given throughout the temperature range by $k_{He}/k_A = 1.2 \pm 0.1$, $k_{SF_6}/k_A = 1.7 \pm 0.2$ and $k_{N_2F_4}/k_A = 1.8 \pm 0.2$. The rate constants are discussed in terms of collision theory. Author

N65-16097# Pennsalt Chemicals Corp., King of Prussia, Pa. Research and Development Dept.
PHOSPHINYLMETHYLPHOSPHINATES AS CHELATING LIGANDS
J. P. King, B. P. Block, and I. C. Popoff Nov. 1964 24 p refs
(Contract Nonr-2687(00))
(TR-43; AD-608201)

Methylphenylphosphinic acids were prepared by hydrolysis of the Michaelis–Arbuzov reaction products of the appropriate chloromethylphosphine oxides and diethyl phenylphosphonite. They react with $Zn(C_5H_3O_2)_2 \cdot 2H_2O$ and $Cr(C_5H_7O_2)_3$ under suitable conditions to yield the corresponding bis and tris chelates, except for the diphenyl-chromium (III) derivative which was prepared in low yield via the chromium (II) derivative. The zinc derivatives are dimers, the chromium derivatives monomers. The metal chelates are more thermally stable than the corresponding acetylacetonates. Their infrared and ^1H NMR spectra are discussed. Author

N65-16108# Aeronutronic, Newport Beach, Calif. Research Labs.
PURIFICATION OF ORGANIC COMPOUNDS BY THERMAL DIFFUSION Final Report, Jul. 1, 1963–Jul. 1, 1964
John L. Richardson, Richard J. Getz, and John C. Britt 15 Sep. 1964 126 p refs
(Contract DA-18-108-AMC-243(A))
(U-2705; AD-610264)

This study consisted of an extensive review of unpacked and packed thermogravitational column theory, an experimental investigation involving both unpacked and packed columns, and an analysis of the experimental results in relation to theoretical predictions. Improvements in column design and operating procedures were developed to facilitate the acquisition of reliable and consistent separation data. The following results were obtained: (1) pure component properties alone cannot predict column performance; (2) separation data for a homologous series can be correlated in terms of property differences with certain restrictions; (3) linear packed column theory is invalid at small permeabilities; (4) characteristic packing size is not an important variable affecting column performance; (5) transient batch packed column performance can be predicted using cell measured binary Soret coefficients; and (6) continuously operated packed column performance is similar to that of the unpacked column in its dependence on the feed flow rate. Author

N65-16147# Carborundum Co., Niagara Falls, N.Y. Research and Development Div.
STRUCTURE OF YB_{12} AND ScB_{12}: INTERSTITIAL COMPOUNDS OF BORON AND TRANSITION METALS
V. I. Matkovich, J. Economy, R. F. Giese, Jr., and R. B. Barrett Oct. 1964 11 p refs
(Contract Nonr-4075(00))
(TR-5; AD-608444)

Preparation of single crystals of YB_{12} and ScB_{12} was carried out, and the structure of both compounds was examined. The ScB_{12} was found to be tetragonal with $a = 5.22$Å and $c = 7.35$Å, space group 14/mmm. The YB_{12} was found to be cubic in agreement with earlier reports. A detailed X-ray structure analysis was carried out to determine whether the form of the B_{12} grouping was cubo-octahedral or icosahedral. The cubo-octahedral grouping of the boron atoms is confirmed which is in agreement with that proposed by earlier writers based on steric considerations. The only variable parameter in the structure is found to be $x = 0.1679$, the B–B distance was determined to be 1.78Å and Y–B distance is 2.79Å. A new method for isolating metastable single crystals using a plasma is described. Author

N65-16150# Hanford Atomic Products Operation, Richland, Wash. Process Engineering and Development Chemical Lab.
ION EXCHANGE RECOVERY OF CESIUM FROM ALKALINE SUPERNATANT WASTE: SCALE-UP STUDIES
R. P. Popovich Sep. 1964 49 p refs
(Contract AT(45-1)-1350)
(HW-83461) OTS: $3.00

This study resulted in the development of a model from which the breakthrough history of a tracer concentration may be estimated to within 10% over a wide range of operating parameters. The model is illustrated for the removal of cesium from Purex-type alkaline supernatant waste with the inorganic ion exchange resin, AW-500. Author

N65-16162# Midwest Research Inst., Kansas City, Mo.
MASS SPECTROMETER STUDY OF METAL-CONTAINING FLAMES Twelfth Quarterly Technical Summary Report, 1 Jul.–30 Sep. 1964
Thomas A. Milne and Frank T. Greene 12 Nov. 1964 13 p refs
(Contract Nonr-3599(00); ARPA Order 23-63)
(AD-451076)

The free radical OH was quantitatively sampled from H_2-O_2 and CH_4-O_2 one-atmosphere flames at temperatures from 2300° to 3000° K. Oxygen atoms and hydrogen atoms were also sampled from H_2-O_2 flames. A summary is given of equilibrium constants for various high temperature equilibria studied so far in this program. Agreement is within a factor of two in $K_{eq.}$ in almost every case. Author

N65-16168# Little (Arthur D.) Inc., Cambridge, Mass.
SYMMETRY OF THE HYDRATION ATMOSPHERES OF IONS AND THE TEMPERATURE-DEPENDENCE OF THE VISCOSITY B-COEFFICIENT
R. A. Horne 30 Nov. 1964 4 p refs Submitted for Publication
(Contract Nonr-4424(00))
(TR-5; AD-608437)

Several published articles pertaining to the temperature dependence of the viscosity B-coefficient of ions in aqueous solution are reviewed and compared. From an analysis of the reported observations, it is concluded that the ease with which thermal energy can disrupt the hydration atmosphere of an ion should increase with increasing concentration, because, as concentration increases, the waters in the atmosphere of a given ion become aware of the presence of nearby ions and their loyalties become increasingly divided. As the concentration of salt solutions approaches $55/(N_c + N_a)$, where N_c and N_a are the number of waters in the first solvation sheath of the cation and anion, respectively, at infinite dilution, B should undergo changes as a result of concentration dehydration. D.S.G.

N65-16175# Istituto di Chimica Industriale del Politecnico, Milan (Italy).
VIBRATIONAL SPECTRA OF HIGH POLYMERS Final Report, Sep. 1963–Aug. 1964
Giulio Natta [1964] 142 p refs
(Contract DA-91-591-EUC-3079)
(AD-451456)

Cyclic ethers with molecular features similar to those occurring in etherlike polymers were synthetized and their conformation and configuration determined by the IR and NMR spectroscopy. In the first part, the synthesis and purification of highly regular polyoxypropylene and polymethylene

are described, and the various conditions for the preparation of orthorombic polyoxymethylene are discussed. In the second part, the results of a simultaneous refinement of the force constants of several ethers and etherlike polymers are reported and discussed. Furthermore, the vibrational spectrum of nearly all transpolymethylene chains is discussed and compared with the results of normal coordinates calculations. For a better understanding of the structure and the vibrations of these molecules and of the others still in a calculation phase, a method was developed to predict the more stable structure of a molecule by a free energy minimization calculation, and a program for a 7090 IBM computer was written for such calculation. This program was tested on saturated hydrocarbon molecules that seemed more apt to the proof. The obtained results were satisfactory. Author

N65-16196# Istituto Superiore di Sanita, Rome (Italy).
TRUE TEMPERATURE COEFFICIENT OF THE ELECTRIC TENSION OF INDIVIDUAL ELECTRODES Final Report, Oct. 1, 1963–Sep. 30, 1964
Giulio Milazzo and Micheline Sotto [1964] 43 p refs
(Contract DA-91-591-EUC-2751)
(AD-451453)

The temperature coefficient of the absolute electric tension of an electrode is determined. A theoretical analysis distinguishes between the nonisothermal temperature coefficient of the electric tension (temperature coefficient of reactional free enthalpy of the individual electrode reaction) and the isothermal temperature coefficient (usual temperature coefficient of the relative electric tension of an electrode.) Experimental equipment is described on a nonisothermal cell which effectively inhibits thermal diffusion of the electrolyte from one half-cell towards the other half-cell. The apparatus includes a potentiometer to measure tensions to 0.1 μV. The temperature coefficient of the redox electrolyte Fe(II)/Fe(III) cyanides is reported, along with plans for work on the standard hydrogen electrode. Author

N65-16205# Joint Publications Research Service, Washington, D.C.
POLYMER COMPOUNDS OF BORON
V. A. Zamyatina and N. I. Bekasova 9 Feb. 1965 26 p refs Transl. into ENGLISH from USP. Khim., v. 33, no. 10, 1964 p 1216–1231 OTS: $1.00
(JPRS-28683; TT-65-30301)

Scientific literature on polymer compounds containing boron is reviewed. The reports cited indicate the methods of synthesis, and describe the properties, structure, and behavior of the compounds. A bibliography of 120 references is included. R.L.K.

N65-16240# Weizmann Inst. of Science, Rehovoth (Israel).
ELECTRICAL ANHARMONICITIES OF DIATOMIC MOLECULES Technical (Scientific) Note No. 13
Nathan Jacobi Nov. 1964 8 p refs
(Contract AF 61(052)-388)
(AFCRL-64-1022; AD-610360)

Although electrical anharmonicities were not included in the well-known treatment of Herman and Wallis—dealing with vibration–rotation interactions in diatomic molecules—they cannot be neglected when intensities of overtone bands are treated. The Herman and Wallis theory is extended here, and values are given for electrical anharmonicities calculated from the overtone bands of a number of diatomic molecules. Author

N65-16284# Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
DILUTE SOLUTION PROPERTIES OF POLY (ISOBUTYL METHACRYLATE). III: STUDY OF THE HUGGINS CONSTANT
Eleanor C. Schramm and Richard J. Valles Jan. 1965 33 p refs
(PA-TR-3204; AD-455669)

The viscosities of methyl ethyl ketone solutions of high molecular weight poly(isobutyl methacrylate) have previously been found to be shear dependent as have the viscosities in acetone. In the work described in this report, four samples of poly(isobutyl methacrylate) were studied in methyl ethyl ketone solutions at 20°, 30°, and 44° C. This work was then combined with the original work at 25° C. The original work at 25° C was run in a different shear viscometer, and the k_1 values obtained with different viscometers cannot be compared. The corrected intrinsic viscosities have been duplicated on both viscometers. The intrinsic viscosity seems to increase with increasing temperature. The Huggins constant k_1 decreases with decreasing shear rate and decreases with increasing temperature. Author

N65-16289# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRON PARAMAGNETIC RESONANCE, II: APPLICATIONS TO CHEMICAL PROBLEMS. EXPERIMENTAL DATA AND THEIR INTERPRETATION
M. K. Kalinowski and A. J. Sadlej 16 Dec. 1964 32 p refs Transl. into ENGLISH from Wiadomosci Chemi. (Poland), v. 17, no. 3, Mar. 1963 p 171–194
(FTD-TT-64-430/1+2+3+4; AD-455509)

In the application of electron paramagnetic resonance several examples of the electron spin resonance spectra of free radicals were given. Included were figures showing the formula of the radical, scheme of formation of hyperfine structure, and resonance sprectrum and distribution of intensities for: 1,1-diphenyl-2-picrylhydrazyl (DFPH) in benzene; N-aminopicrylcarbazyl; 1,1-diphenyl-2-(2-sulfo-4,6-dinitrophenyl)-hydrazyl; singly charged negative ion of naphthalene, and of anthracene; ions of aromatic hydrocarbons; p-benzosemiquinone; p-benzosemiquinone chloroderivatives; semiquinones; paramagnetic ion crystals; and paramagnetic ions in solutions. Use of the paramagnetic resonance method is also possible in chemical kinetics, as many spectra undergo qualitative changes in time, and actual resonance line width of a free radical is dependent on its life period. It was concluded that, as electron spin resonance is the most sensitive method for detecting free radicals, analytical applications of electron paramagnetic resonance are of great importance. M.G.J.

N65-16305*# National Aeronautics and Space Administration, Washington, D.C.
MODERN ASPECTS AND DEVELOPMENT IN FLUORINE CHEMISTRY [MODERNI ASPETTI E SVILUPPI DELLA CHIMICA DEL FLUORO]
D. Sianesi Feb. 1965 35 p refs Transl. into ENGLISH from Chim. Ind. (Milan), v. 46, no. 8, 1964 p 883–894 Presented at the Chem. Congr. 1964, Milan, 21–23 Apr. 1964
(NASA-TT-F-9248) OTS: HC $2.00/MF $0.50

A brief survey is given of production and application of fluorine, including a description of the design and operating characteristics of a modern electrolytic fluorine generator and of problems encountered in the practical use of this generator. Several examples of the application of fluorine in the field of inorganic chemistry are given, and the situation of fluorine in

modern chemistry of organic fluorinated compounds is discussed. Actual processes are described, based directly or indirectly on fluorine, from which a series of products of considerable interst are obtained. Author

N65-16306*# National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATIONS OF FORMATION AND REMOVAL OF HYDROGEN AND OXYGEN DEPOSITIONS ON PLATINUM BY A NEW NONSTATIONARY METHOD [UNTERSUCHUNG DES AUF- UND ABBAUES VON WASSERSTOFF- UND SAUERSTOFFBELEGUNGEN AN PLATIN MIT EINER NEUEN INSTATIONAREN METHODE]
F. G. Will and C. A. Knorr Feb. 1965 37 p refs Transl. into ENGLISH from Z. Elektrochem. (Weinheim), v. 64, 1960 p 258–269 Presented at the 58th Gen. Meeting of the Deut. Bunsen-Ges. für Physik. Chem., Darmstadt, W. Germany, 7 May 1959
(NASA-TT-F-9249) OTS: HC $2.00/MF $0.50

A method of electrode-kinetic measurements and its application to the investigation of adsorption phenomena on platinum are described. The method consists mainly in applying, between the experimental electrode and a reference electrode, a practically no-current direct voltage and a delta potential of variable amplitude and frequency by means of an electronic potentiostat, with subsequent oscillographic recording of the cell current. The formation and dissolution of the hydrogen and oxygen films adsorbed on the electrode surface, as a function of the reference potential, was quantitatively determined by graphical integration of the resultant current-time curves. The reaction inhibitions present in the buildup and decomposition of the film were investigated by varying the delta frequencies. An especially pronounced inhibition was obtained in the dissolution of the oxygen adsorption layers, but a characteristic inhibition was also observed in the formation and dissolution of hydrogen films. Author

N65-16307*# National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF ADSORPTION PHENOMENA IN RHODIUM, IRIDIUM, PALLADIUM, AND GOLD USING THE POTENTIOSTATIC DELTA METHOD [UNTERSUCHUNG VON ADSORPTIONSERSCHEINUNGEN AN RHODIUM, IRIDIUM, PALLADIUM, UND GOLD MIT DER POTENTIOSTATISCHEN DREIECKMETHODE]
F. G. Will and C. A. Knorr Feb. 1965 18 p refs Transl. into ENGLISH from Z. Elektrochem. (Weinheim), v. 64, 1960 p 270–275
(NASA-TT-F-9250) OTS: HC $1.00/MF $0.50

Experimental results using an established method of potentiostatic application of delta potentials are given, primarily on the thickness of the hydrogen and oxygen adsorption layers on the noble metals rhodium, iridium, palladium, and gold as a function of the reference ptoential. For rhodium, the maximum hydrogen deposition on the roughened surface was 62%, for iridium 45%, and for gold only 3%. This deposition depended on the potential velocity and on the pretreatment. The oxygen deposition, as also the oxygen evolution, starts for the individual metals at slightly differing potentials and increases steadily in the entire investigated range up to 2.2 V, except for iridium. In iridium, at a potential velocity of 1 V/sec, no further increase in the oxygen layer beyond a monatomic film was observed above 1.6 V. Several characteristic test data, obtained with the delta method, are compiled in a table giving a comparison of the investigated noble metals. Author

N65-16323# College of Aeronautics, Cranfield (Gt. Brit.)
SOME REACTIONS OF PERFLUOROGLUTARIC ACID
D. A. Smith Nov. 1964 60 p refs
(CoA-NOTE-MAT-4)

Perfluoroglutaric acid when reacted with methyl magnesium iodide affords 2,6 diol 2,6 dimethyl hexafluoropyran in high yield and 4-one, 1,2,3 hexofluorocaproic acid in low yield. The former material appears to exist in a range-melting form (64° to 79° C) and a very labile form of melting point 96° to 98° C. The 2,6 diol 2,6 dimethyl hexafluoropyran yields a mono semicarbazone, and also a mono and a di 2:4 dinitro phenyl hydrazone. The mono 2:4 dinitrophenyl hydrazone appears to be cyclic. Reduction both with lithium aluminium hydride and sodium borohydride yields 2,6 diol 3,4,5 hexafluoro n-heptane. There is evidence to suggest that reaction with dried calcium sulphate gives 2-ene, 2 methyl 3,4,5 hexafluor 6-one cyclohexane. Reaction with benzoyl chloride affords 2,6 dibenzoate 2,6 dimethyl hexafluoropyran. The 4-one 1, 2,3 hexafluorocaproic acid was characterized as a 2:4 dinitro phenyl hydrazone and also as an S-benzyl thio-uronium salt. Infrared spectral evidence suggests the S-benzyl thio-uronium salt probably exists in the straight chain form. Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-15525# United Electrodynamics, Inc., Alexandria, Va. Seismic Data Lab.
REVERBERATION EFFECTS ON SIGNAL AMPLITUDE
Robert Van Nostrand 30 Oct. 1964 20 p
(Contract AF 33(657)-12447; Proj. Vela Uniform)
(Rept.-410; AD-450449)

It was found that resonance is the most important factor in signal amplitude variation resulting from changes in near surface geology. To a lesser extent, the acoustic impedance of the surface rock is also important, a smaller acoustic impedance at the surface leading to a larger signal amplitude. As an order of magnitude, the signal amplitude may vary by a factor of three or four due to such causes in an idealized case; in practice, the variation is probably less. In general, it was concluded that the signal amplitude in a region of sedimentary cover is higher than that in a shield region. However, in cases where the sedimentary sections contain limestones with high velocities, as at DH NY, the signal can actually be lower than in the shield area. Author

N65-15544# Melabs, Palo Alto, Calif.
INVESTIGATION OF MICROWAVE NON-LINEAR EFFECTS UTILIZING FERROMAGNETIC MATERIALS Quarterly Progress Report, Feb. 17–Jul. 7, 1964
Lee F. Donaghey [1964] 13 p
(Contract DA-36-039-SC-89206)
(QPR-9; AD-607945) OTS: $1.00

Recent experimental work in progress on the longitudinally pumped magnetodynamic parametric amplifier is discussed. The pump power threshold for oscillation for the amplifier described was as low as 5.5 watts peak using a pulsed mode of pumping. Author

N65-15553# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
THE RADIATION FIELD OF AN ELECTRIC DIPOLE ANTENNA IN A CONICAL SHEATH
A. Banos, Jr., R. H. Huddlestone, D. C. Pridmore-Brown, and E. C. Taylor 30 Oct. 1964 48 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-184; TDR-469(5220-10)-2; AD-455406)

The radiation pattern of an electric dipole antenna that is situated on the axis of a cone of finite conductivity, such as a conical plasma sheath, was calculated. The mathematical analysis of the idealized model was carried out rigorously, and the solution is presented as a rapidly converging series of modes. Radiation patterns are given for parameter values of interest in reentry situations. The dominant feature of the patterns is found to be the presence of a guided wave traveling out along the conical sheath. A discussion of the relevance of these results to the blackout problem is included. Author

N65-15554# Aerospace Corp., El Segundo, Calif. Satellite Systems Div.
DESIGN DIFFERENCES BETWEEN MILITARY AND COMMERICAL COMMUNICATION SATELLITES
W. L. Pritchard and Neil Mac Gregor Dec. 1964 53 p refs
(Contract AF 04(695)-469)
(TDR-469(5111-01)-1; SSD-TDR-64-271; AD-453999)

A single satellite is considered first, and it is shown how military needs for security and survivability lead to one estimate of communication capacities, while the commercial desire for revenue leads to another (of higher capacity). Frequency selection is discussed, as is the effect of ground station configuration and data processing. Major system aspects are then covered with particular reference to coverage, survivability, communication reliability, multiple access, and launch economics. Typical system calculations are presented, followed by a brief discussion of the divergent growth potentials and interests of military and commercial systems. Discussions of communication satellites are clouded by several misconceptions and/or prejudices. The principal offenders, such as the differences between operational systems and experiments and the either/or nature of the arguments used, are discussed and put into perspective. Author

N65-15576# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
EXACT RADAR CROSS SECTION OF AXISYMMETRIC CONDUCTING TARGETS
P. C. Waterman 11 Nov. 1964 56 p refs
(Contract AF 04(694)-498)
(RAD-TM-64-61; AD-451196)

A new method is proposed for the computation of radar cross section and other associated field quantities arising when a smooth, perfectly conducting target is illuminated by an incident electromagnetic wave. The scattered wave is described by a distribution of electric dipoles over the surface in question, with the response from any dipole proportional to the induced surface current density at that point. The surface current may be determined by the boundary condition that the scattered wave, through interference, precisely cancels the incident wave inside. Obtained is a pair of coupled (infinite) matrix equations for the surface current. Green's identity permits decoupling of the equations, reducing the problem to roughly the equivalent of two independent scalar problems. The equations are further specialized to axially symmetric targets, and are solved numerically on the IBM 7094 for several examples of interest. Reciprocity and energy conservation are also examined, and the resonant mode (interior) problem is set up explicitly in matrix form. Author

N65-15590*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A DICHROIC SUBREFLECTOR FOR CASSEGRAIN ANTENNA SYSTEMS
Robert L. Hensell and Paul A. Lantz Dec. 1964 32 p refs
(NASA-TM-X-55121; X-525-64-395) OTS: HC $2.00/MF $0.50

A Cassegrain subreflector has been designed that permits prime-focus feeding of the paraboloidal reflector by a feed looking through the hyperboloidal subreflector. This subreflector is frequency sensitive and reflects the frequency band 6.0 to 16.0 Gc while passing the frequency band 4.0 to 6.0 Gc. Resonant objects on the subreflector are effective for all polarizations. Reflection properties are equivalent to those obtained with a solid metallic subreflector. Transmissivity is equivalent to that obtained with no subreflector in place. Author

N65-15607# Columbia U., New York, N.Y. Electronics Research Labs.
ELECTRO-OPTICAL SIGNAL PROCESSING TECHNIQUES FOR PHASED ARRAY ANTENNAS Quarterly Progress Report, Jul. 1–Sep. 30, 1964
L. Lambert 1 Oct. 1964 33 p refs
(Contract AF 49(638)-1113; ARPA Order 279)
(CU-49-64-AF-1113-ERL; P-4/199; AD-451410)

The response of the spatially multiplexed system with a new ultrasonic transducer is shown to be very near to the theoretical when operating with a simulated signal from a uniform antenna-aperture distribution. Sidelobe suppression techniques by means of aperture weighting are briefly discussed. The two weighting functions considered are the Hamming-type and the truncated gaussian. A preliminary experimental result of the system response to a Hamming-type weighted aperture is presented. The time-multiplex signal simulator design is continued. The schematics for the carrier multiplex path, the control and transmission gate, and the frequency doubler subassemblies are included. Author

N65-15618# Westinghouse Electric Corp., Baltimore, Md. Westinghouse Defense and Space Center
BACKSCATTER FLIGHT TEST PROGRAM REPORT
Oct. 1964 38 p
(Rept.-1878A; AD-608274) OTS: $2.00

The backscatter measurement flight test was conducted to fill a gap in the existing terrain reflectivity data at vhf frequencies. A radar system, essentially consisting of a Navy type SK transmitter, a modified Vitro Model 1308 receiver, a TR device to keep the transmitted signal out of the receiver, and a broadbeam sidelooking antenna, was installed in a Beechcraft Queenair aircraft. Returns from flatland, water, city, mountain, and woods terrains were recorded on film. The receiving subsystem was calibrated, and various parameters such as peak transmitted power, pulsewidth, and antenna pattern were measured. The film data were read out for down-look angles from 7° to 60°. To compute the received power and σ_0, a parameter describing the terrain backscatter reflectivity per unit area, for each terrain-type and downlook angle, 125 samples were read and the median found. The city and woods have the highest reflectivity, and the flatland and water reflectivities are the lowest. The mountain data are questionable because the mountain was a considerable distance away and at fairly slight elevation relative to the aircraft's altitude. Author

N65-15622# Harvard U., Cambridge, Mass. Cruft Lab.
CURRENTS, CHARGES, AND NEAR FIELDS OF CYLINDRICAL RECEIVING ANTENNAS

Ronold W. P. King 19 Aug. 1964 32 p refs
(Contract Nonr-1866(32))
(TR-453; AD-608282) OTS: $2.00

The cylindrical center-loaded receiving antenna in an incident linearly polarized plane-wave field was analyzed. Approximate expressions were obtained for the distributions of current and charge that involve three trigonometric terms with suitably defined coefficients. These are much more accurate than the usual zero-order currents and charges, and are much simpler than higher-order iterated solutions. The complex effective length is determined. Formulas are also obtained for the reradiated or scattered field very near the antenna in the important special case when the antenna lies in the plane of the incident wave front. These are useful in certain applications that involve radio-frequency hazards. Author

N65-15623# Harvard U., Cambridge, Mass. Cruft Lab.
THE CYLINDRICAL ANTENNA WITH ARBITRARY DRIVING POINT
Ronold W. P. King and Tai Tsun Wu Oct. 1964 42 p refs
(Contract Nonr-1866(32))
(TR-455; AD-608283) OTS: $2.00

A new reasonably accurate approximate solution was obtained in trigonometric form of the distribution of current and the admittance of a cylindrical antenna when driven offcenter. The symmetrical problem (sleeve dipole) with two equal generators at the same distances from the center is solved first, then the antisymmetrical case with equal and opposite generators. A suitable superposition of the two results provides the solution for the dipole antenna when driven at an arbitrary point along its length. The results are sufficiently simple to be useful in the study of antennas with active or passive elements located along their length. Author

N65-15631# RAND Corp., Santa Monica, Calif.
TOPICS IN SIGNAL ESTIMATION
P. Swerling Oct. 1964 73 p refs
(P-3007; AD-608387) OTS: $3.00

It is shown that the maximum a posteriori (MAP) estimate for the case where a priori statistics are associated with unknown parameters is equivalent, under certain conditions, to a maximum likelihood (ML) estimate in a problem in which the a priori statistics are regarded as providing additional equivalent observations of the parameters. Mixed MAP–ML estimates are defined for cases in which some, but not all, of the parameters are assumed to have a priori statistical distributions. A class of generalized least-squares estimation procedures are formulated which give the ML–MAP estimates, if the statistics are gaussian, but which remain good estimates even for non-gaussian statistics. The analysis is applied to linear minimum variance filtering theory and to additive noise problems. The application of the results to the problem of obtaining recursive solutions to certain very general forms of the signal estimation problem is then presented. D.S.G.

N65-15647# California U., Livermore. Lawrence Radiation Lab.
AIRBORNE SCAN-CONVERTER SYSTEM
Stanley W. Thomas 13 Oct. 1964 29 p refs
(Contract W-7405-ENG-48)
(UCRL-7952)

A method of converting very high bandwidth, single-transient information in a rocketborne experiment to a much lower bandwidth is described. Application of the scan conversion technique to single-transient information of nsec rise-time permits conversion to bandwidths commensurate with present day telemetry systems. Signal-storage rise-time capability is 1 to 10 nsec depending on the type of storage tube used. Of special interest is the unique transistorized linear sweep. Its delay between trigger and start of the sweep is less than 6 nsec, and the sweep voltage is plus and minus 400 V. Other transistorized circuitry, such as readout sweep, time base generator, and signal amplifier, is also discussed. Author

N65-15648# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
SUPPLEMENT TO MARCUM'S AND SWERLING'S DATA ON TARGET DETECTION BY A PULSED RADAR
L. F. Fehlner Sep. 1964 128 p
(Contract NOw-62-0604-c)
(TG-451A; AD-608354)

A supplement to the graphed target-detection data is presented. The same data are given in a tabulated form for more precise needs, with the addition of data for 6000 pulses that were integrated incoherently. This presentation permits a better interpolation for the intermediate values of the pulsed-radar target detection. G.G.

N65-15652# Weapons Research Establishment (Australia).
AN ANALYSIS OF THE EXPECTED ACCURACY OF SLV IMPACT PREDICTION FOR FLIGHT SAFETY PURPOSES
J. G. Rodger May 1964 42 p refs
(WRE-TN-ISD-45)

An estimate is made of the effect of tracking noise and data filter lags on the accuracy with which the impact point of a Satellite Launcher Vehicle (SLV) can be determined from measurements made during the motored phase of the vehicle's flight. These estimates are then combined with other factors to determine the position of the cutdown lines on the safety displays to ensure that there is a probability no greater than 1 in 1000 of a malfunctioning missile transgressing the impact limit lines of the prescribed area for SLV trials. Author

N65-15654# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEMS OF THE STATISTICAL THEORY OF RADAR
P. A. Bakut, I. A. Bol'shakov et al 19 Oct. 1964 418 p refs Transl. into ENGLISH of the book "Voprosy Statisticheskoy Theorii Radiolokatsii" Moscow, Izd. "Sovetskoye Radio" 1963 p 1–424
(FTD-MT-64-113; AD-608462) OTS: $7.20

The statistical theory of radar is discussed. The basic problems of the theory of detection are expounded, as well as the problems of radar measurements and target resolution. Methods for analysis and synthesis of radar systems are treated, as are many results and rules obtained by these methods. The book is designed for teachers and those acquainted with the basic aspects of the theories of probability and the theories of random processes. The necessary information from the theory of statistical resolution is given. This book is also intended for scientific workers and engineers, those concerned with radar problems, and also for postgraduate students and students of corresponding specialties. Author

N65-15657*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TELEMETRY INSTRUMENTATION OF THE ECHO II PASSIVE COMMUNICATIONS SATELLITE

Harold S. Horiuchi Oct. 1964 15 p refs Presented at the 8th Intern. Conv. on Mil. Electron. MIL-E-CON 8, Washington, D.C., 14–16 Sep. 1964
(NASA-TM-X-55117; X-621-64-281) OTS: HC $1.00/MF $0.50

An Echo II electronic beacon telemetry system is described that provides a tracking signal and monitors the skin temperature and measures the internal pressure of the satellite, with emphasis on data acquisition during the initial inflation stages. The system consisted of two redundant amplitude-modulated rf transmitters operating at Minitrack frequencies of 136.02 and 136.17 Mc. The rf power of the two beacons was about 35 to 39 milliwatts each. The package contains four solar modules for recharging of the batteries. Pressure and temperature readings were taken from the initial inflation state of the balloon and through two orbits and are presented in charts. Data on the varying rotation speed, and also on the location of the spin axis of the satellite are included. G.G.

N65-15691# ITT Federal Labs., Nutley, N.J.
ANTI-JAMMING TECHNIQUES. PART II: HARD LIMITING SATELLITE EXPERIMENT Task Report, Task I, 1 Nov. 1963–31 Jan. 1964
M. Epstein, I. Krause, and H. Silver Mar. 1964 83 p refs
(Contract DA-36-039-SC-90886)
(TD-64-89; AD-453730)

Tests were conducted to determine the effects of single and double limiting upon four FM signals. Suppression effects and intermodulation measurements were made for several frequency spacings. The spectrum generated by four cw signals was examined to verify the limiter theory. Thus far, most of the observed results are in good agreement with theory. The following conclusions can be drawn: (1) Double limiting is somewhat better than single limiting in generation of intermodulation products. (2) At favorable spacings, intermodulation distortions are −30 dB at channel deviations of 20 kc and −40 dB at channel deviations of 200 kc. (3) Double limiting eases the problem of ground power control because the amplitude of one signal affects only its cochannel member amplitude. With four equal input signals the power wasted in spurious sidebands is 2 dB for each signal. Author

N65-15693# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A LINEAR-FM RADAR PULSE COMPRESSION SYSTEM EMPLOYING THICKNESS-TAPERED DISPERSIVE DELAY LINES
R. C. Yost 11 Jul. 1963 24 p refs
(Contract AF 19(628)-500)
(TR-321; AD-419468)

This report describes a radar pulse compression system that employs a linear FM signal. At the option of the operator, the shape of the signal envelope can be made rectangular, Butterworth, or Gaussian. Ultrasonic dispersive delay lines that are thickness tapered to provide a linear group time delay characteristic over a frequency band of 2 Mcps are used as the signal expansion and compression devices. Included are the test results of the completed unit with photographs of the waveforms. For the poorest case, the time sidelobes in the receiver output waveform are shown to be 35 dB below the peak response. The receiver for the rectangular signal and the receiver for the Butterworth signal are mismatched with accompanying losses in the radar sensitivity of 1.7 dB and 0.7 dB, respectively. An uncompensated Doppler frequency shift of 1 kcps will produce an error of 7 ft in the estimate of the range to an echoing object. Author

N65-15694# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
PRECISION SYNCHRONIZATION OF RADARS, PHASE I
Willis S. Parsons May 1963 85 p refs
(ERDA-21; AD-404798)

A laboratory analysis of atomic rubidium and cesium-beam atomic oscillators showed that they can be adjusted to the same frequency or that they cross in frequency. A frequency difference and variance of 8.4 parts times 10^{-12} was found for rubidium oscillators, and similar results were noted in the analysis of cesium beam oscillators. A cross correlation of oscillator pairs proved that the rubidium oscillators were more accurate and stable. Their ability to hold the frequency settings over 90 days greatly aids in the adjustment and setup required for synchronization of radar systems. G.G.

N65-15703# Stelma, Inc., Stamford, Conn.
DEVELOPMENT OF ELECTRICAL SYNCHRONIZER SN-293()/G Final Report, 20 Mar. 1962–26 Aug. 1964
R. Martello [1964] 48 p
(Contract DA-36-039-SC-88946)
(Rept.-4; AD-451531)

This report includes (1) discussions of circuits and components considered for use, during the course of development, and evaluations of the approaches finally chosen for use in the equipment; (2) design-consideration details and test results that led to electrical and mechanical features incorporated in the equipment; and (3) detailed logic discussions of the final circuitry used in the equipment. Author

N65-15708# California U., San Diego. Visibility Lab.
A SYSTEM FOR MEASURING THE QUADRATIC CONTENT OF TELEVISION SIGNALS
Benjamin L. Mc Glamery Sep. 1964 29 p refs
(Contract NObs-84075)
(SIO-Ref.-64-8; AD-606402)

A system was devised for the measurement of the quadratic content of television signals. A unique feature of this system is that the video signal from the television system is connected directly to an oscilloscope and the measurement taken from the CRT using an optical mask technique. In addition to the measurement of quadratic content and rms values, the system can measure other properties of the signal if the appropriate mask is substituted for the square law mask. The system is composed partly of commercially available instruments and requires the construction of only a few electronic circuits. The construction of the optical and mechanical components is simple and straightforward. Accuracy of the system for quadratic content measurements is approximately ±20%; for rms and signal-to-noise measurements, it is approximately ±10%. Author

N65-15751# Watkins-Johnson Co., Palo Alto, Calif.
RADIO INTERFERENCE MEASURING SET AN/URM-100 (XE-1) Quarterly Technical Report No. 5, 26 Jun.–25 Sep. 1964
William E. Budd, Robert C. Hilquist, Marshall H. Hollimon, and Dale E. Miller [1964] 44 p
(Contract DA-36-039-AMC-02328(E))
(W-J-64-621R15; AD-453350)

The stabilized backward-wave oscillator local oscillators were investigated and refined; and four local oscillator sweeper subassemblies, based on the final design, were wired. An S-band tuner was fabricated and partially aligned and checked

out. The other three tuner modules used in the rf rack are in various lesser states of completion. The YIG driver rack was completed, except for cabling and final checkout. The data handling rack was also completed, except for some circuit development work, rack cabling, and final checkout. The three major units in this rack, the magnetic core memory, digital chassis, and control chassis, were fabricated installed, and partially checked. The IF subsystem was installed in the IF rack, and tests are in progress to realign where necessary and check out the circuits to insure their proper integration with the rest of the system. Author

N65-15799# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A STUDY OF RADAR CLUTTER IN TRADEX Group Report 1964-29
G. R. Curry 25 May 1964 33 p refs
(Contract AF 19(628)-500; ARPA Order 166; Proj. Defender)
(ESD-TDR-64-334; AD-441068)

Measurements of clutter with the TRADEX radar at uhf and L-band are described. Clutter is shown to be due to sea return and returns from clouds. Sea clutter predominates at ranges less than 13 n. mi., values of σ_o of −100 dB being typical at both frequencies. Coherent scattering from clouds is postulated, and the observed frequency independence of the cloud returns is offered as supporting evidence. Values of cloud cross section per unit volume are given. Below 15 000-ft alt, values of −140 dB are typical at both frequencies. Clutter spectra are presented. Author

N65-15812# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SIGNAL PARAMETER ESTIMATION FOR SEISMOMETER ARRAYS Technical Report No. 339
E. J. Kelly, Jr. and M. J. Levin 8 Jan. 1964 37 p refs
(Contract AF 19(628)-500; ARPA Order 512; Proj. Vela Uniform)
(ESD-TDR-64-11; AD-435489)

Statistical methods are applied to the estimation of the velocity, direction of arrival, and waveform of a signal appearing in an array of sensors, with particular attention to seismological problems. The signal is assumed to be a plane wave propagating through a linear homogeneous nondispersive medium so that it is the same in each sensor except for a time delay due to its finite velocity. A least-squares procedure is first described that does not depend on any assumptions regarding the noise. A maximum-likelihood procedure based on gaussian noise with known cross-spectral density matrix is then developed. Expressions are derived for the asymptotic variances of the estimates of the components of the time delay vector and for the mean-square response of the processor to the input noise. The results are compared with those obtained when the signal waveform is known completely except for amplitude and time delay. Specific results are calculated for white noise independent between sensors, and for unidirectional noise. The relationship of the maximum-likelihood processing to that derived from the multidimensional Wiener filtering theory is examined. Author

N65-15829# Rome U. (Italy).
THE INCREASE OF PRECISION IN THE ANALOGICAL TRANSMISSION OF DATA [L'AUMENTO DELLA PRECISIONE NELLA TRASMISSIONE ANALOGICA DEI DATI]
Giorgio Ravelli 1964 31 p refs In ITALIAN *Its* Atti del Centro Ricerche Aerospaziali No. 4

Methods for increasing the precision of analog data transmissions, particularly for telemetry data, are described.
Trans. by P.F.E.

N65-15925# Stanford Research Inst., Menlo Park, Calif.
ON MODELING THE TIME-VARYING FREQUENCY-SELECTIVE RADIO CHANNEL, PART II
Robert F. Daly Jul. 1964 46 p refs
(Contract DA-36-039-SC-90859)
(SRI-TR-2, Pt. II; AD-451278)

This report is concerned with the mathematical characterization of a scattering radio channel. A model is developed that treats the radio channel as a randomly time-varying linear filter. By viewing the filter's transfer function as a homogeneous random field defined on the time-frequency plane, the channel scattering function is introduced in a natural fashion. The interpretation of the channel scattering function as the density of power scattered by the channel, as a function of doppler shift and time delay is discussed. Four useful functions are developed that serve to characterize the second-order properties of the time and frequency structures of an arbitrary process. The manner in which a scattering radio channel transforms an input second-order measure into an output second-order measure is of interest to the communication engineer, and is treated in detail. Author

N65-15934# Joint Publications Research Service, Washington, D.C.
INDIVIDUAL S10-60 EQUIPMENT FOR MULTICHANNEL LONG-DISTANCE COMMUNICATIONS SYSTEMS
N. M. Driatskiy and A. I. Kharitonov 3 Feb. 1965 82 p Transl. into ENGLISH from the book "Individualnoye Oborudovaniye S10-60 dlya Mnogokanal'nykh Sistem Dal'ney Svyazi" Moscow, "Svyaz" Publishing House, 1964 p 4-64
(JPRS-28614; TT-65-30271) OTS: $3.00

This equipment provides normal operation of telephone channels as well as secondary consolidation channels for voice frequency telegraph, phototelegraph, and the transmission of data and broadcast programs over duplex and triplex channels. The new innovations were: the replacement of electronic tubes by transistors; reduction of the overall dimensions for the equipment by more than a factor of two by using small-size parts and printed wiring; the use of a voice frequency dialing ringing receiver with greater protectivity from false operation with increased noise values; the installation of voice frequency ringing generators with a frequency of 2100 and 1600 cps, as well as those with 1000 and 500 cps, to provide uninterrupted operation of voice frequency ringing generators. R.E.S.

N65-15936# Atlantic Research Corp., Alexandria, Va. Jansky and Bailey Div.
TROPICAL PROPAGATION RESEARCH Semiannual Report, Jan.-Jun. 1964
[1964] 72 p ref
(Contract DA-36-039-SC-90889; ARPA Order 371)
(SAR-4; AD-451045)

This report presents results from the field measurements made through May 1964. The field data were reduced to graphic form, generally in terms of basic transmission loss as a function of distance and antenna height. Certain auxiliary data, such as path profile data and refractive index data, are also reported. The field data obtained from the measurements at 100 megacycles were analyzed extensively by comparing the measured data with the theoretical data calculated from the same terrain profiles, distances and antenna heights, but without vegetation. The results of this analysis, although limited to one example, begin to indicate that the rate of attenuation due to the tropical vegetation alone decreases as the path length is increased. These results are also presented in this report. Author

N65-15947*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENTS TO DETERMINE COMMUNICATION CAPABILITY OF THE ECHO II SATELLITE
W. C. Nyberg, R. L. Kaiser, and W. E. Leavitt (Collins Radio Co., Dallas, Tex.) Oct. 1964 7 p Presented at the 8th Intern. Conv. on Mil. Electron., Washington, D.C., 16 Sep. 1964
(NASA-TM-X-55118; X-621-64-291) OTS: HC $1.00/MF $0.50

The experiments were divided into two categories: (1) to determine directly and quantitatively the characteristics of the Echo II satellite as a radiofrequency reflector; and (2) to demonstrate some of its communications capabilities. Tests in the first category included measurements of the received signal level, and provided data for the effective cross-sectional area of the satellite and for the signal fading and scintillation characteristics. The demonstrational type experiments included an audiofrequency transmission test utilizing tones, voice and music, and facsimile and digital data transmissions The experiments established the Echo II bandwidth capability at 12 Mc. The satellite had good transmission capabilities and met the design objective of becoming a rigidized structure. G.G.

N65-15950# IIT Research Inst., Chicago, Ill.
ELECTRONIC EQUIPMENT CHARACTERISTICS—RADAR TYPES Second Quarterly Progress Report, 15 May–15 Aug. 1964
B. Ebstein, J. J. Krstansky, P. Mc Manamon, I. N. Mindel, R. D. Standley et al [1964] 90 p refs
(Contract DA-28-043-AMC-00004(E))
(Rept.-2; AD-451476)

The areas of investigation considered include transmitter spectrum signature measurements using a pattern integration technique, multimode attenuators, plus experimental data on the M33 acquisition radar antenna. The conclusions reached were: (1) Multimode attenuators which do not produce serious mode conversion can be constructed using distributed lossy material which is uniform in the transverse plane. This makes possible further consideration of mode launchers as receiving devices. (2) The M33 radome exhibits no stop bands up to 10 gc. (3) The M33 reflector and supporting structures pass vertically polarized waves at all frequencies with about 6 dB loss. (4) Multimode studies are an important consideration in the evaluation of monopulse tracking systems because of the complex nature of the waveguide structures used to resolve the desired components of the received signal. Author

N65-15953# Smyth Research Associates, San Diego, Calif.
A STUDY OF TRANSMISSION OF WEATHER AND OCEANOGRAPHIC DATA FROM FLOATING WEATHER STATIONS Final Report
W. J. Fay, D. R. Muñoz, and S. Weisbrod Oct. 1964 60 p refs
(Contract N189(188)57835A)
(SRA-416; AD-451408)

Presented is a limited study of the transmission of weather and oceanographic data from floating weather stations. It is confined to those areas of investigation specifically related to the composite transmission problem with some specific applications to the NOMAD project. The characteristics of the h-f antenna aboard an ocean buoy station were investigated. The relationships existing between channel capacity, bandwidth, and signal-to-noise ratio are discussed. Types of codes and methods of decoding from the standpoint of information and decision theory are discussed. A study is made of possible improvements to buoy system performance through the use of accurate timing devices. The relationship of accurate clock timing and frequency stability to synchronous FM systems is shown. Author

N65-15961*# Purdue U., Lafayette, Ind. Electronics Systems Lab.
[LEARNING SYSTEMS, ADAPTIVE SYSTEMS, SIGNAL DESIGN, AND CHANNEL MODELS FOR SPACE COMMUNICATION—COMMUNICATION THEORY AREA] Annual Report for 1964
J. C. Hancock et al Jan. 1965 58 p refs
(Grant NsG-553)
(NASA-CR-60431) OTS: HC $3.00/MF $0.50

Considered is the usefulness of learning theories in the synthesis of digital data systems. Included in the study are a simulated learning system and its comparison to other learning systems; the development of a learning technique capable of classifying and recognizing patterns; experiments with intersymbol interference in binary channels; and a study of cognitive signal processing. Some adaptive systems, or those that attempt to measure the unknown properties of the channel and use the measurements in the processing of the data, are discussed. Included are studies of differential phase shift keying, decision-directed kineplex and adaptive processing of troposcatter data. Also reported are: (1) signal design in selection and representation, including a comparison of two methods of combating intersymbol interference in digital data systems; (2) digital communications systems optimization for channels with memory; (3) design of distinguishable synchronization sequences; (4) signal selection in a class of non-gaussian noise; and (5) channel models for space communication. R.E.S.

N65-15964# Stanford U., Calif. Radioscience Lab.
DISCRETE VLF EMISSIONS FROM THE UPPER ATMOSPHERE Technical Report No. 3412-6
Neil M. Brice Aug. 1964 160 p refs
(Grants AF-AFOSR-62-370; NSF G-17217; NSF GA-56; NSF GP-1191)
(SEL-64-088; AD-610424)

A new mechanism for the generation of emissions by energetic electrons—the transverse-resonance plasma instability—was found. The existence of this instability depends on the electron velocity component transverse to the earth's magnetic field rather than the component along the field. The emitted signals propagate along the field in a direction opposite to the drift of the electrons. An investigation was made of VLF emissions recorded by satellites. Two distinct types of signals were observed only in satellites and are referred to as intra-ionosphere emissions. It appears that one of these emission types arises from a resonance between waves and ambient (as opposed to energetic) charged particles for quasi-transverse propagation, while the other arises from a resonance between ambient charged particles and left circularly polarized (Alfven) waves propagating quasi-longitudinally. These resonances are found only when the motions of the ions are considered. Author

N65-15965# Stanford U., Calif. Radioscience Lab.
THE EFFECTS OF THE AURORA ON RADIO WAVE PROPAGATION Final Report
A. M. Peterson Oct. 1964 55 p refs
(Contract AF 19(604)-7994)
(SEL-64-123; AFCRL-64-922; AD-455004)

The research included a detailed theoretical study of the generation of synchrotron noise by auroral electrons spiraling in the earth's magnetic field. Experiments were conducted to detect ion-gyro modulation on radar returns from

field-alined irregularities such as those associated with the aurora. A model of auroral radar reflections is discussed that hypothesizes acoustic waves excited by current streams that flow in the ionization enhanced regions at the base of auroral forms. A study was made of the effects on radio wave propagation of high velocity streams of electrons such as those in the solar wind. Author

N65-15974# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
COMMUNICATION BY ELECTROENCEPHALOGRAPHY
E. M. Dewan Nov. 1964 12 p refs *Its* Spec. Repts. No. 12
(AFCRL-64-910; AD-608970)

The alpha rhythm can be blocked by visual concentration to control an electric switch at will. This could in turn be used for purposes of control or communication directly via EEG signals—in other words, by thought manipulation. Although practical applications of this idea have yet to be investigated, the actual demonstration of a thought-controlled device is in itself of interest. Author

N65-16005# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
A STUDY OF A SCINTILLATION MECHANISM
Kurt Toman Nov. 1964 17 p refs Presented at 9th AGARD Ionospheric Res. Comm. Symp., Copenhagen, 26–29 Aug. 1964 *Its* Phys. Sci. Res. Papers No. 71
(AFCRL-64-942; AD-609848)

Scintillation was observed during an experiment with an Hg 198 light, a rotating mirror, and a Fabry–Perot interferometer. The mechanism postulated for the phenomenon is an acceleration component in the ray path, caused by curvatures within the mirror surfaces. Author

N65-16014# Rome Air Development Center, Griffiss AFB, N.Y.
ANALYSIS OF DOPPLER DATA FROM ECHO II
Edward E. Cossette Nov. 1964 36 p refs
(RADC-TDR-64-444; AD-610120)

Measurements were made using the Passive Satellite Research Terminal at the Floyd test site. Prior to these measurements, orbital element data received from space track agencies were used to predict the expected doppler frequency as a function of time in an on-site digital computer. The computed doppler frequency was subtracted from the measured doppler frequency every second to obtain the doppler difference. The results of the data revealed that a sizable time error existed in the computed data. This resulted in much larger doppler uncertainties than were expected. Author

N65-16057# CBS Labs., Stamford, Conn.
TRANSDUCER AND INTERCOMMUNICATION SYSTEM FOR AIR CREWMAN'S PROTECTIVE HEADGEAR First Quarterly Progress Report, 23 Jun.–30 Sep. 1964
Robert L. Townsend, Frank L. Ragonese, and Alfred L. Di Mattia 30 Oct. 1964 26 p refs
(Contract DA-28-043-AMC-00282(E))
(Rept.-1; AD-610478)

System analysis of cordless intercommunication is underway. As a result, preference for a carrier frequency between 20 and 30 mc, rather than 400 mc, was developed. Also, the desirability of several voice channels for adjacent, but distinctly separate, aircrews is evident. Based upon literature study, a technique suited to the present need for evaluation of speech communications in the presence of noise has tentatively been adopted and is described. Author

N65-16064# Michigan U., Ann Arbor. Radiation Lab.
MODIFICATION TO THE SCATTERING BEHAVIOR OF A SPHERE BY REACTIVE LOADING Scientific Report No. 2
V. V. Liepa and T. B. A. Senior Oct. 1964 78 p refs *Its* Rept.-5548-2-T
(Contract AF 19(628)-2374)
(AFCRL-64-915; AD-609903)

Electromagnetic scattering behavior by a metallic sphere loaded with a circumferential slot in the plane normal to the direction of incidence is investigated. The slot is assumed to be of small but nonzero width with electric-field constant across it, and under this assumption the analysis of external field is exact. The field scattered in any direction is obtained by superposition of the field diffracted by an unloaded sphere, and that radiated by an excited slot at the position of the load, with the radiation strength of the slot related to the loading characteristics in the combined problem. Thus, there are two parameters that determine the scattering behavior of this object: the loading admittance and the position of the slot. Numerical results are presented primarily for the case of back scattering, and these are compared with experimental measurements made using a metallic sphere with an equatorial slot backed by a radial cavity of adjustable depth. Author

N65-16121# Innsbruck U. (Austria).
VLF MEASUREMENTS IN THE MINE OF BLEIBERG Scientific Report No. 11
Wolfram Bitterlich and O. Gröbner 15 Oct. 1964 10 p refs
(Contract AF 61(052)-490)
(AFCRL-64-1013; AD-610024)

Measurements of vlf propagation in rock showing considerable mineralization are described by: (1) the measurement of field strength decrease as dependent on the distance; (2) the measurement of the radiation pattern of the transmitting antenna at short distances in inhomogeneous, strongly mineralized rock; and (3) the field strength measurement of signals of remote vlf transmitters at different depths. The measurements in the experiment showed that the inhomogeneities can be proved with satisfactory accuracy only by choosing the frequency and distance measurements adequately. Besides these measurements conducted by means of a vlf transmitter, the reception of vlf transmitters over large distances was measured and the results showed that the difference in propagation expected qualitatively could not be observed. The flat trend of the horizontal curve was in good agreement with previous measurements. R.E.S.

N65-16122# Hughes Aircraft Co., Culver City, Calif.
RADIATION PATTERNS OF ANTENNAS ON PLASMA ENCLOSED CYLINDERS Scientific Report No. 7
J. H. Harris, A. T. Villeneuve, and L. A. Broca Oct. 1964 52 p refs
(Contract AF 19(604)-8386)
(P64-110; AFCRL-64-993; AD-609930)

The radiation patterns of an infinitesimal longitudinal magnetic line source on a plasma enclosed cylinder are presented. In the cases considered, the plasma is a homogeneous cylindrical layer that is not contiguous with the cylinder. Patterns are shown as a function of the colatitude angle, θ, for various values of the layer thickness and the constitutive parameters of the plasma. Transmission through lossy as well as lossless sheaths is considered. The discussion includes a summary of the mathematical problem, computational considerations, and leaky wave effects. Author

N65-16135# Cornell U., Ithaca, N.Y. Center for Radiophysics and Space Research
A STUDY OF WAVELENGTH DEPENDENCE OF TRANS-HORIZON RADIO PROPAGATION Final Report
R. Bolgiano, Jr. 15 Jun. 1964 74 p refs
(Contract AF 19(604)-3494)
(CRSR-188; AFCRL-64-561)

Investigations include studies of fading, of wavelength dependence, of median diversity effect, or anomalous propagation over irregular terrain, and of information theoretic analysis of troposcatter circuits. It is concluded that for the path involved the wavelength dependence of excess propagation loss does vary in a seemingly erratic manner from day to day and in a more consistent way seasonally. Higher frequencies are more favored in summer. The short-term median signal levels on adjacent paths of a space diversity system may vary in an uncorrelated manner, but this variation is considerably less than that between circuits widely separated in frequency on the same path. Author

N65-16138# Joint Publications Research Service, Washington, D.C.
MAGNETIC RECORDING IN AUTOMATION
V. N. Shadrin 10 Feb. 1965 156 p refs Transl. into ENGLISH of the book "Magnitnaya Zapis' v Avtomatike" Moscow, State Power Eng. Press, 1962 p 1–120
(JPRS-28702; TT-65-30307) OTS: $5.00

The theory and techniques of magnetic recording in automation are presented. The physical principles are explained in detail, including the chief characteristics of the media. The technical principles include those of methods and of types of mechanisms. The magnetic properties of permeability, induction, coercive force, and the reluctance of the materials are investigated. The methods and characteristics of direct recording, FM, PM, PDM, and PCM are described. Use of information theory in analyzing the basic properties of magnetic recording, e.g., in an information channel, and the application of V.A. Kotel'nikov's theory of potential noiseless transmission to magnetic recording are also discussed. Expressions are derived for these computations. The basic rules of information theory and of the theory of potential noiseless transmission are expanded. R.E.S.

N65-16214# Stanford Research Inst., Menlo Park, Calif.
AN ERROR-RATE EXPRESSION FOR HF DPSK COMMUNICATIONS SYSTEMS
N. Thomas Gaarder Aug. 1964 41 p refs
(Contract DA-36-039-SC-90859)
(TR-3; AD-451277)

This memorandum develops an error-rate expression for binary-differential-phase-shift-keyed and quaternary-differential-phase-shift-keyed communication systems that use second-order, postdetection combined space diversity and a time- and frequency-varying hf propagation medium for the transmission of information. The propagation medium output is assumed to be the sum of an additive noise and the outputs of several independent paths. Each path has a random gain, Rayleigh distributed with a known variance dependent upon the particular path; a random phase shift, uniformly distributed; a known time delay; and a known doppler shift. The probability-of-error expression accounts for the effects of intersymbol interference, interchannel interference, frequency-selective fading, time-selective fading, and additive noise. In order to bound the diversity receiver operation, probability-of-error expressions are computed for statistically independent and for completely dependent (identical) dual-diversity receiver inputs. The sensitivity of the systems to perturbations in the time delays, doppler shifts, relative strengths, and number of paths is discussed. Author

N65-16321*# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group
LOW NOISE, HIGH EFFICIENCY CASSEGRAIN ANTENNA STUDIES Final Report, 1 Apr.–31 Dec. 1963
[1963] 290 p refs
(Contract NAS5-3282)
(NASA-CR-60573; FR-64-14-8) OTS: HC $6.00/MF $1.50

An antenna figure of merit proportional to the gain of the antenna divided by the noise temperature of the system is defined and discussed in detail. This report contains both the analytical and experimental studies based on this figure of merit concept. The analytical study establishes the theoretical limitations of an ideal antenna and the degree of physical realizability of the ideal. The upper limit of performance is thus established, and the lower limit is the present state-of-the-art in conventional antenna systems. The figure of merit concept enables a numerical figure of merit to be assigned to different antennas for purposes of comparison. This is done for a representative number of existing antennas, and is presented in a table. This antenna figure of merit concept was extended to tracking antennas. D.E.W.

N65-16334# Federal Aviation Agency, Washington, D.C. Communications Development Div.
STUDY ON THE COST-BENEFITS OF RECORDING ON VOICE CHANNELS Final Report
Raymond R. Barkalow Dec. 1964 22 p
(RD-64-159)

The necessity of 30-day storage procedure for voice recording tape was considered in an effort to save on the annual expenditure of funds. It was concluded that a reduction in storage time to 15 days would be more than adequate to satisfy all recipients of voice recordings. Recommendations were made to change the procedure from 30-day to 15-day storage, and for purposes of accident investigation, retain all tapes for that day on which the accident occurred. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-15456 Picatinny Arsenal, Dover, N.J. Reliability Branch
THE COLLECTION, PROCESSING AND STORAGE OF DATA ON SERIALIZED NW ITEMS
Manfred W. Krimmer *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 99–109 (See N65-15451 06-19)

The application of a Quality Assurance Instruction (QAI) to seralized nuclear weapons items, and the fundamentals of the error and summary computer programs, are outlined. The QAI standardizes the method of data collection and processing. The automatic data processing system includes standardization of forms, recording methods, and conversion of data to punch cards. Computation, analysis and interpretation of the data then takes place. D.S.G.

N65-15549# Boeing Co., Seattle, Wash.
THE BOEING NON-EQUILIBRIUM PLASMA DYNAMICS COMPUTER PROGRAM
W. A. Massena, Alfred C. Hunting, and John W. Thomas [1964] 231 p refs
(Contract AF 33(615)-1791)
(D2-23524; AD-446580)

Presented is a computational scheme for calculating the nonequilibrium air-plasma flow over the X-20 lower surface. A program compatible with the IBM 7090 digital computer is included. The air plasma consists of 12 species, including the products of dissociation and ionization of N_2 and O_2. Among these species are three diatomic molecules, three monatomic molecules, three diatomic ions, two monatomic ions, and, in addition, free electrons. The interactions between these species are represented by a total of 10 reversible chemical reactions, including dissociation, ionization, and exchange reactions. Equations are derived for the gas flow and for the kinetics of the chemical reactions. As examples of the operation of the program, graphs are included of the electron density along the lower surface of the X-20. Complete program listings are presented for the main program and for the major subroutines. Author

N65-15560# Aerospace Corp., Patrick AFB, Fla. Eastern Test Range Office

GEMINI QLAP REQUIREMENTS, PART I

M. L. Schauerman 16 Nov. 1964 69 p

(Contract AF 04(695)-469)

(TOR-469(A5126-10)-1; AD-452120)

This study processes a formatted pulsed-code-modulation data tape in conjunction with calibration and configuration data to produce an output in engineering units for the Quick Look Analysis Program (QLAP). This output will produce a binary tape of all the parameters in engineering units, plots of engineering units data versus time, and tabulated listings of other selected parameters. G.G.

N65-15629# Adaptronics, Inc., Alexandria, Va.

STUDY OF NEUROTRON NETWORKS IN LEARNING AUTOMATA. VOLUME I: LEARNING AUTOMATA AND THE NEUROTRON Final Engineering Report, 15 Feb. 1963–15 Feb. 1964

L. O. Gilstrap, Jr., A. C. Chauliagon, H. J. Kempa, and R. E. J. Moddes 15 Jun. 1964 64 p refs

(Contract AF 33(657)-10734)

(AD-608306) OTS: $3.00

A theory of learning automata, with mathematical formulation, is presented and applied to the development of the experimental neurotron (a neuromime with the ability to learn both analog and logical functions). Construction of this neuromime is detailed, and logic and circuit diagrams are presented. This report also includes a detailed manual of operation for the experimental neurotron. No extensive discussion of applications is given. Author

N65-15630# Adaptronics, Inc., Alexandria, Va.

STUDY OF NEUROTRON NETWORKS IN LEARNING AUTOMATA. VOLUME II: COMPUTER SIMULATION Final Engineering Report, 15 Feb. 1963–Feb. 1964

R. F. Snyder, R. J. Brown, and R. E. J. Moddes 15 Jun. 1964 62 p

(Contracts AF 33(657)-10734; DA-36-034-AMC-0099(Z))

(AD-608307) OTS: $3.00

Descriptions and flow diagrams for the simulation of a Neurotron (a neuromime with the ability to learn both analog and digital functions) network are presented. The program was prepared for the IBM 7094 computer and is encoded in a subroutine complex in FORTRAN IV and Macro-Assembly program code (MAP) for use with the IBM IBJOB Monitor System. Although exact applications to learning and goal situations are not included, these aspects are discussed to a degree that allows complete use of the simulation vehicle in specific problem areas. Author

N65-15645# General Electric Co., Huntsville, Ala. Computer Dept.

AN ALGORITHMIC APPROACH TO THE PROBLEM OF GRAPH ISOMORPHISM DETERMINATION

William J. Wilson Huntsville, Ala. Army Missile Command, 15 Feb. 1964 13 p refs

(Contract DA-01-021-AMC-242(Z))

(RSIC-203; AD-451272)

In the computer manipulation of chemical structure analogs, graph isomorphism determination emerges as a problem. Aspects of this problem and approaches to its solution are discussed. Author

N65-15651# European Atomic Energy Community, Brussels (Belgium).

STUDIES FOR A DATA HANDLING INSTRUMENTATION SYSTEM IN THE CBNM

H. Meyer Oct. 1964 20 p refs

(EUR-2101.e) Available from Belg. Am. Bank and Trust Co., N.Y., Account No. 22.186: 40 Belg. Fr.

Presented are some general aspects for a data handling system to be constituted by several flexible standard units as a wired program system, the wiring of which should be adaptable to given needs. A storage tube system is being studied. An integrating memory and display unit for monitoring during recording and for precise viewing of sorted data off-line is proposed. The characteristics of developed buffer storages, of coding devices and sorting memories available, and of a magnetic tape handling system are also given. Author

N65-15745*# Massachusetts Inst. of Tech., Cambridge. Computation Center

A DESCRIPTION OF A COMPUTER PROGRAM FOR THE STUDY OF ATMOSPHERIC EFFECTS ON SONIC BOOMS

Manfred P. Friedman Feb. 1965 75 p refs

(Contract NAS1-2511)

(NASA-CR-157) OTS: HC $3.00/MF $0.75

An approach to the problem of a shock propagating through a variable atmosphere is presented. A previously presented theory was improved, and a computer program was written using the results of the improved theory. This paper presents the improved results and gives a detailed description of the computer program. For an atmosphere that varies arbitrarily in the vertical direction, and for a supersonic aircraft with arbitrary lift and volume distribution the computer program will give the shock overpressure and intersection points at the ground. In addition, effects due to aircraft acceleration, flightpath angle and curvature, and acoustical cutoff are computed and presented by the program. Author

N65-15765# Naval Radiological Defense Lab., San Francisco, Calif.

A FAST, PUNCHED-CARD READOUT SYSTEM FOR PULSE-HEIGHT ANALYZERS

B. A. Euler, P. L. Phelps, and D. F. Covell 16 Jun. 1964 39 p ref

(USNRDL-TR-775; AD-450634)

The application of digital computer techniques to the analysis of pulse-height spectra is one of the important areas of development of gamma-ray scintillation spectrometry. As a result, an increasing interest has developed in techniques for coupling the pulse-height analyzer to the computer. An IBM-523 Gang Summary Punch, in conjunction with a specially built buffer unit, is used to provide punched card readout from a 256-channel pulse-height analyzer. Complete readout is accomplished in 12 seconds. The use of punched cards contributes

the additional advantages of an easily organized data file and ready accessibility to the data. The card-punch buffer unit is capable of converting binary-coded decimal notation (BCD) to binary notation. It has an eight-word AND gate matrix which allows the insertion of seven record-identification and information words into the punch card readout, along with the 256 words of pulse-height data. Author

N65-15768# Aerospace Corp., Patrick AFB, Fla.
PROGRAM 624A: QLAP REQUIREMENTS, PART II
M. L. Schauerman 18 Dec. 1964 110 p
(Contract AF 04(695)-469)
(TOR-469(A5116-56)-2, Vol. I; AD-454037)

The Quick Look Analysis Program (QLAP) is used to process formatted PCM data tapes in conjunction with other source data to provide an early source of performance information for the vehicle's propulsion, guidance, control, electrical and structural systems, and its aerodynamic environment and external tracking systems. This second part of the three-part reporting system processes the engineering units tape (the output of part I) along with supplemental meteorological information and tracking data. The derived parameters include outages, flow rates, thrust, specific impulse, etc. The output parameter format is also presented. D.S.G.

N65-15780# Stanford Research Inst., Menlo Park, Calif.
DEVELOPMENT OF A MULTIPLE INSTANTANEOUS RESPONSE FILE: THE AN/GSQ-81 DOCUMENT DATA INDEXING SET Final Report
E. L. Younker, D. C. Condon, C. H. Heckler, Jr., D. P. Masher, and J. M. Yarborough Griffiss AFB, N.Y., RADC, Oct. 1964 129 p refs
(Contract AF 30(602)-2772)
(RADC-TDR-63-414; AD-609126)

An experimental model of an electronic reference retrieval file, in which all file entries are interrogated simultaneously was designed and constructed. The principal purpose of this work was to demonstrate the usefulness of a rapid-feedback, man–machine relationship in a data retrieval system. The experimental model is designed to store the indexes to 5000 documents. Each document is given an accession number and is described by up to eight English words '(descriptors) selected from a 3000-word dictionary. The delivered model contains a 1000 word dictionary and the indexes to 1100 documents. A search question, consisting of one to eight descriptors in their natural English form, is entered by means of an electric typewriter. The machine indicates immediately whether or not any file item satisfies the search question, and if so, how many file items respond. The machine then resolves multiple responses and types out the accession number and the full set of descriptors of each responding document. Author

N65-15785# MITRE Corp., Bedford, Mass.
THE ROLE OF SIMULATION AND DATA REDUCTION PROGRAMS IN THE DEVELOPMENT OF REAL-TIME SYSTEMS
E. L. Lafferty AFSC, Electron. Systems Div., Dec. 1964 27 p
(Contract AF 19(628)-2390)
(SR-125; ESD-TDR-64-169; AD-609500)

This report deals with the valuable use of simulation and data reduction computer programs in the acquisition and engineering of command and control systems. The value of simulations, especially in facilitating the learning process and in expediting system design, is described. Data reduction is shown to be an evolutionary process, and the design of a data reduction system should be considered in the very early stages of system acquisition. Some model simulation and data reduction system software are examined, and several considerations in their design are enumerated. The importance of the system engineer's recognition of the constantly changing nature of all his instrumentation is stressed as being all-important in the design of support systems that provide an overall effectiveness. Author

N65-15795# Burroughs Corp., Radnor, Pa.
STORM RADAR DATA PROCESSOR EVALUATION Final Report
John Bradley et al 31 Aug. 1964 132 p
(Contract AF 19(625)-2956)
(AD-609820)

To properly evaluate and improve the operating characteristics and reliability of the Storm Radar Data Processor system (STRADAP), two phases of evaluation were performed—analysis and evaluation of the hardware, and theoretical or mathematical analysis of the concepts utilized. The hardware analysis consists in testing, through the use of standard test equipment and under normal operating conditions, individual circuits, logic blocks, and the entire system to insure correct function, tolerances, accuracy, and reliability. As a result of this evaluation, modifications deemed necessary were designed, fabricated, installed, and checked out. Math analysis was performed to evaluate the sampling techniques and averaging techniques used by STRADAP, as well as the capability of the input radar video to provide sufficiently accurate information to allow STRADAP to accomplish the conversion to an accurate digital representation of cloud and storm formations within the range of the radar. Author

N65-15826# Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
ANALOG COMPUTER SIMULATION OF A PULSED EXTRACTION COLUMN
R. D. Benham and N. P. Wilburn Sep. 1964 36 p refs
(Contract AT(45-1)-1350)
(HW-83818) OTS: $2.00

Several advanced computer techniques were used successfully to determine the best fit of a mathematical model to a set of physical data obtained from a pulsed solvent extraction column. Two mathematical models representing different types of operating conditions for the extraction column were selected for the simulation: the simplified model, which assumes that no organic solution is existent below the feed plate, and the complex model, which simulates buildup of organic solution in this region. Initial conditions and boundary equations are defined for both. The programs for both models, for the automatic random minimizing of the error-squared integral, and for the data reduction system, are described. The MIDAS (Modified Integral Digital Analog Simulation) program was used as an independent check of the analog results. Conclusions are drawn regarding the important points involved in the use of analog computers for optimization and mathematical model fitting. D.S.G.

N65-15850 Lincoln Lab., Mass. Inst. of Tech., Lexington.
HAYSTACK POINTING SYSTEM: INTERPOLATION
R. Teoste 28 Oct. 1964 30 p refs
(Contract AF 19(628)-500)
(AD-608289) OTS: $2.00

The Haystack antenna is pointed by means of a Univac 490 Computer. In the Pointing System program, an interpolation routine is incorporated to provide pointing information 250 times a second. This report describes the interpolation routine. Author

N65-15857# Oak Ridge National Lab., Tenn. Reactor Div.
NBC—AN IBM 7090 COMPUTER PROGRAM FOR SOLVING THERMOELASTIC PROBLEMS
F. J. Witt Jan. 1965 52 p refs
(Contract W-7405-ENG-26)
(ORNL-3624) OTS: $3.00

The work of various individuals and groups was combined to provide a numerical means for calculating stresses in bodies with the use of either a plane–strain or a plane–stress model. The particular problem considered is the evaluation of thermal or irradiation-induced stresses for arbitrary temperature or irradiation-exposure distributions. A computer program, NBC, is described that may be used to solve the two-dimensional nonhomogeneous biharmonic equation pertinent to the analysis of simply connected and multiply connected regions. The material may be isotropic or it may only exhibit isotropy in the plane of the cross section. The biharmonic equation and related boundary conditions are derived, and an example is presented. Complete instructions for using the program are given. Author

N65-15894# American Machine and Foundry Co., Alexandria, Va.
SIMULATION AND MODEL OF AN INPUT-OUTPUT UNIT FOR AIRBORNE COMPUTERS Technical Report, Aug. 1964–Sep. 1964
Sander Rubin Dec. 1964 64 p
(Contract AF 33(657)-9208)
(AFAL-TR-64-312; AD-454938)

The developmental program described was initiated to produce a model of a device capable of encoding decimally entered information, displaying decimal output information, and converting between the binary notation of a computer and the decimal notation of the operator. This model represents a medium of communication between a navigator and an airborne navigational computer. It contains thumbwheel switch inputs, a fixed program, a special-purpose computer coupled to a simulated navigational computer interface, and a novel display device with opto-electronic feedback. The decimal display was found to be inadequate, and several changes in its construction were suggested. Author

N65-15933# RAND Corp., Santa Monica, Calif.
THE LOGIC OF INTERROGATING A DIGITAL COMPUTER
M. E. Maron Nov. 1964 25 p refs Presented at the 1964 Linguistic Inst. of the Linguistic Soc. of America, Indiana U., Bloomington
(P-3006; AD-608367) OTS: $1.00

The multidisciplinary problem of interrogating a digital computer involves techniques and fields ranging from semantics and philosophy of language to the study of information-flow mechanisms. An outline of the origin and scope of the information sciences is given, and the two subproblems of literature searching and data retrieval are examined from a logical point of view, so that a practical attack on them might succeed. The problems of knowing and comprehending are discussed for some aspects, and are related to the information-flow organization to generate "comprehending-like" behavior. It was concluded that an artifact would have to embody a model of its world to exhibit indications of knowing, gaining information, etc. G.G.

N65-15988# Mitre Corp., Bedford, Mass.
USER'S MANUAL FOR THE COMPUTERIZED ELECTRONIC SYSTEM COST MODEL: 7030 MODIFICATIONS
B. L. Moores AFSC, Electron. Systems Div., Oct. 1964 34 p
(Contract AF 19(628)-2390)
(ESD-TDR-64-126; TM/03651/0000/00/1/00; AD-608065)

A computerized electronic system cost model was developed. The changes that resulted from converting the computer program for the model from FORTAN II for the IBM 7090 to FORTRAN IV for the IBM 7030, and from implementing several operational improvements are described. Author

N65-16015# Rome Air Development Center, Griffiss AFB, N.Y.
AN ANALYSIS OF THE MULTIPLE INSTANTANEOUS RESPONSE FILE
Ronald J. Ferris Dec. 1964 27 p
(RADC-TDR-64-457; AD-610131)

This report clarifies the functional capability of a device called the multiple instantaneous response file (MIRF). The MIRF is a document surrogate storage and retrieval device that employs a mechanically alterable, read only, content addressable, parallel search memory. Organization of the memory permits the user of the file to be on-line in addition to providing automatic search refinement functions. Some attention is given to the evaluation of MIRF, but this involves essentially a review of the evaluation problem. This report does not discuss the hardware aspects of the MIRF but it does briefly mention the applicability of memories having the same basic features. Author

N65-16018# Mitre Corp., Bedford, Mass.
ORBITAL FLIGHT AND COVERAGE SIMULATION
L. E. Wilkie and J. W. Stevens Dec. 1964 106 p refs
(Contract AF 19(628)-2390)
(W-07106/0000/00/0/00; ESD-TDR-64-156; AD-609502)

This report describes the current effort toward establishing a workable engineering simulation of the space–ground environment. This report describes the simulation of ground station coverage of a vehicle from the end of powered flight to an arbitrary time in orbit. Signal strengths of several vehicle–ground-station antenna combinations, as well as geometrical coverage, are simulated. A spherical earth model was used in the simulation, and the effects of atmospheric drag and orbital perturbations were neglected. Author

N65-16032# General Electric Co., Washington, D.C. Information Systems Operation
SIMULATION AND ANALYSIS OF 473L SYSTEM. VOLUME I: SIMULATION OF 473L SYSTEM OVER A RANGE OF OPERATING CONDITIONS Final Report
Stanley B. Rosen, John P. Mc Cabe, Essie S. Nevans, Richard Walden, John Falvey et al Bedford, Mass., AFSC, Electron. Systems Div., Dec. 1964 37 p refs
(Contract AF 19(628)-3843)
(ESD-TDR-64-656, Vol. I; AD-609763)

The overall 473L Command and Control System was modeled and simulated to predict performance over a range of operating conditions. Disc access time was the variable of primary interest, and performance was measured in terms of response time, computer and disc utilization, and total storage requirements. An analytic solution was derived that substantiated the simulation results. Response time and storage capacity were found to be adequate, but it is recommended that the central processor assume more of the processing load and that the complex priority interrupt scheme be simplified. Author

N65-16033# General Electric Co., Washington, D.C. Information Systems Operation
SIMULATION AND ANALYSIS OF 473L SYSTEM. VOLUME III: ANALYSIS OF SERIAL AND PARALLEL FILE STRUCTURES Final Report

Stanley B. Rosen, John P. Mc Cabe, Essie S. Nevans, Richard Walden, John Falvey et al Bedford, Mass., AFSC, Electron. Systems Div., Dec. 1964 40 p refs
(Contract AF 19(628)-3843)
(ESD-TDR-64-656, Vol. III; AD-609765)

This study was undertaken to determine if the introduction of data redundancy can reduce search time in storage and retrieval applications that use magnetic tape. Serial and parallel file structures and directories on magnetic tape and disc memories were examined. It was concluded that search time can be improved through utilization of data redundancy and the random-access features of disc memory. Author

N65-16035# American Science and Engineering, Inc., Cambridge, Mass.
COMPUTER PROGRAMS AND NUMERICAL RESULTS RELATED TO THE PROBLEM OF THE SOLAR WIND Final Report, Part II
Yvain M. Treve 1 Jul. 1964 181 p
(Contract AF 19(628)-2388)
(ASE-653; AFCRL-64-594(II); AD-609941)

Numerical integrations of the differential equations of several hydrodynamical models of the solar wind were performed for various sets of initial conditions. The method of integration is described, and a summary of the results is given together with a listing of the FORTRAN programs used. Also included are tables of various quantities related to the theory of atmospheric evaporation as applied to the solar corona. Author

N65-16060# Cutler-Hammer, Inc., Deer Park, N.Y. Airborne Instruments Lab.
ADVANCED SELECTIVE MONITORING SYSTEMS Technical Report, Jan. 1963–Jun. 1964
A. Babich and G. Morton Wright-Patterson AFB, Ohio, AMRL, Nov. 1964 53 p ref
(Contract AF 33(657)-10462)
(AMRL-TR-64-97; AD-610255)

To reduce the amount of data obtained in multiple-input data acquisition systems—subsequently reducing power and size requirements in space vehicles, or reducing processing time in a computer analysis—a selective monitoring system was built and tested. The present system is an extension of a laboratory model that was used as criteria for signal selection signal changes from a steady-state and signal excursions beyond predetermined limits. That system (laboratory model) was expanded to include originating (encoding) and terminal (decoding) equipment for a PCM data-transmission channel. The encoding and decoding equipment used the selective-monitoring characteristics of the laboratory model to obtain a data transmission rate lower than that required in an ordinary multiple input data acquisition system. Signals selected by the encoder unit were reconstructed in the decoder unit. A rate analog processor, compatible with the selective monitoring system, and suitable for use as a cardiotachometer, was built and tested. Performance requirements in an operational system are described. The reduction in size and power consumption obtainable with microminiaturization is analyzed. Author

N65-16071# Air Force Systems Command, Bedford, Mass. Electronic Systems Div.
THE DECISION SCIENCES LABORATORY PROGRAM OF TECHNIQUES AND FACILITIES FOR AUTOMATING RESEARCH
Emir H. Shuford, Jr. Sep. 1964 48 p refs
(ESD-TDR-64-553; AD-608421)

This is a report on the application of techniques and the use of computer facilities in automating research in the Decision Sciences laboratory. Applications are divided into six categories: (1) real-time control of experimental tasks performed by human subjects, (2) statistical analysis of experimental data, (3) stimulation and sensitivity analyses, (4) studies in information retrieval, (5) techniques for improving the man–computer interface, and (6) computer-based personnel selection, classification, training, and proficiency testing. Examples are given of each application. There is also a detailed facility layout and description of equipment characteristics. Author

N65-16092# Massachusetts Inst. of Tech., Cambridge.
VERBAL AND GRAPHICAL LANGUAGE FOR THE AED SYSTEM Progress Report
Douglas T. Ross and Clarence G. Feldman [1964] 29 p refs
(Contracts Nonr-4102(01); AF 33(600)-42859; Proj. MAC)
(MAC-TR-4; AD-604678)

For design use, a single language which can take either verbal or graphical form is required. This paper describes how a single language processing technique, which is in turn a special application of more general concepts concerning the step-by-step growth and processing of large structures of interrelated elements, can efficiently process both language forms in the same manner. Illustrations of the concepts involved are also drawn from the methods used in the AED-0 Compiler, an efficient ALGOL-60-based compiler used in computer-aided design work. Author

N65-16217# Atomic Energy of Canada Ltd., Chalk River, Ontario.
THE ACQUISITION AND PROCESSING OF RADIATION EXPOSURE DATA AT THE CHALK RIVER NUCLEAR LABORATORIES
G. B. Knight and P. C. Rowe Sep. 1964 17 p refs
(AECL-2114) Available from Atomic Energy of Canada Ltd., Chalk River: $1.00

A new photobadge has been in use since December 1962, capable of indicating external gamma-ray exposures and beta-ray skin doses. The radiation exposure data acquisition and processing system has been modified to report this information routinely. A detailed radiation exposure history is maintained in a kardex file for every monitored worker. Group analysis of the exposure data is handled by computer, using punched cards. Group listings of the radiation exposures are distributed, and each exposed worker is informed in writing. Author

N65-16221# RAND Corp., Santa Monica, Calif.
COMPUTER RECOGNITION OF ON-LINE, HAND-WRITTEN CHARACTERS
M. I. Bernstein Oct. 1964 32 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-3753-ARPA; AD-451231)

A method is discussed for recognizing single, hand-written characters using an online graphical input device, such as a digitizing pantograph, a light pen, or the RAND Graphic Input Tablet, as the primary information source. Basically, the method consists of filtering and smoothing the input stream to eliminate as much redundancy as possible. Direction of the stylus movement is quantized into one of eight directions, allowing each stroke of a character to be described as a series of connected straight line segments. By eliminating various measures on the stroke, the description is size-, position-, and rotation-independent. In order to restore some rotational orientation and to discriminate between open, closed, and multistroke characters, end-point comparisons are added to the description. Author

N65-16243# General Electric Co., Washington, D.C.
SIMULATION AND ANALYSIS OF 473 L SYSTEM. VOLUME II: SIMCOM AND SIMSCRIPT SIMULATION TECHNIQUES; A COMPARISON Final Report
Stanley B. Rosen, John P. Mc Cabe, Essie S. Nevans, Richard Walden, John Falvey et al Bedford, Mass., AFSC, Electron. Systems Div., Dec. 1964 17 p refs
(Contract AF 19(628)-3843)
(ESD-TDR-64-656, Vol. II; AD-609764)

A comparison of the efficiency of the Simcom and Simscript simulation techniques was made based on their application to a common simulation model. The results demonstrated that Simcom is more efficient in the initial setup stage and that Simscript is more efficient in the production stage. Curves of cost versus the number of production runs were plotted showing the number of production runs at which the two techniques require the same expenditure of funds. Author

N65-16274# College of Aeronautics, Cranfield (Gt. Brit.)
AN ANALOGUE COMPUTER WITH ITERATIVE COMPUTING FACILITIES
R. J. A. Paul, J. E. Fisher, H. B. Gatland, and A. J. Martin Aug. 1964 58 p refs
(CoA-E&C-2)

A description is given of a new electronic analog computer whose purpose is to investigate the possible capability of performing iterative calculations. A few examples of the application are included to illustrate the scope of such a facility. The iterative operation is obtained by adopting asynchronous mode control of integrators instead of the conventional synchronous control. Although such machines are now available commercially, there is little published information on their utilization. A further feature of the new machine is the incorporation of generalized computing units described previously. Author

N65-16277*# Stanford U., Calif.
OPTIMAL BOUNDED CONTROL OF LINEAR SAMPLED-DATA SYSTEMS USING QUADRATIC PERFORMANCE CRITERIA
Gary W. Deley Apr. 1963 68 p refs
(Grant NsG-133-61)
(NASA-CR-50596; SUDAER-148) OTS: HC $3.00/MF $0.75

Optimal control of linear sampled-data systems, where the control is subject to saturation, is investigated. The system is described by the state-space method. The control is considered to be optimal when it minimizes a performance index which is defined as a sum over the sampling instants of a quadratic function of the states and controls. The solution begins with the principle of optimality. A form is assumed for the optimal return function, and recurrence relations are derived for the one-input case that are different, depending on whether the optimal control is or is not saturated. The optimal control is shown to be a piecewise linear function of the states. A computing method that uses the recurrence relations to solve the infinite stage regulator problem is presented. This method requires less computer time and memory than would straight dynamic programing. Both one- and two-input control are considered. A detailed discussion of a simple method for finding the minimum of a positive definite quadratic function in two variables, subject to the constraint that the minimum be on or within a rectangle, is presented. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-15566 Naval Ordnance Lab., Corona, Calif.
THIN MAGNETIC FILM PARAMETRONS
R. L. King and J. H. Johnson *In its* Foundational Res. Pro, 1 Jun. 1963 p 1-6 (See N65-15565 06-34)

Experiments were conducted to test the basic theory and to determine the optimum parametron design under operating conditions. A circuit diagram of a commercially available thin-film parametron used in these tests is presented. The primary winding is a single, straight, No. 20 AWG copper wire, on the surface of which is deposited a 25% iron–74% nickel alloy film, 14 900 Å thick, to form the magnetic core. The primary winding carries the excitation current at the pumping frequency of 2f, and also the dc bias current. The secondary winding, which is around the axis of the single wire of the primary, is connected in parallel with a capacitor to form a circuit resonant at one-half the pumping frequency. Author

N65-15592*# General Electric Co., Waynesboro, Va. Industrial Electronics Div.
STUDY OF CAPACITORS FOR STATIC INVERTERS AND CONVERTERS Final Report
J. F. Scoville 30 Oct. 1964 75 p
(Contract NAS3-2788)
(NASA-CR-54248; R63SCW-31-5) OTS: HC $3.00/MF $0.75

The objectives of this study of capacitors for application in aerospace static inverters and converters were to determine the state-of-the-art capacitors, their ac characteristics, and their safe operating voltage and temperature that are consistent with reliability and weight objectives. An analysis was made of the operation and losses of commutating capacitors. Capacitance change and dissipation factors of polycarbonate, metallized paper, and tantalum capacitors are presented. Author

N65-15614*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
FLYBACK VOLTAGE REGULATOR
Gail D. Smith Washington, NASA, Feb. 1965 17 p refs
(NASA-TN-D-2627) OTS: HC $1.00/MF $0.50

The flyback voltage regulator provides a regulated output dc voltage from a widely varying input dc voltage to supply a widely varying output load. Its salient features are good regulation, high efficiency, adjustable output voltage, constant frequency of operation, and rapid response to sudden changes in input voltage and output load. The regulator employs the flyback phenomenon of an inductor to boost the input voltage and to provide a regulated output voltage. A single high-frequency, high-power, low-saturation resistance, switching transistor is used to connect the inductor in the charge and discharge or flyback circuits. The performance is shown by curves of the efficiency, ripple, and output voltage. These curves reveal the efficiency to be greater than 90% for a load of 60% to 100% of the maximum output power rating (44 watts) with an input of 12 to 20 volts. Author

N65-15696# Stanford Research Inst., Menlo Park, Calif.
RELIABLE DIELECTRIC FILMS FOR MICROCIRCUITS Semiannual Technical Report, Apr. 1–Aug. 31, 1964
Saul W. Chaikin and Gilbert A. St. John 26 Oct. 1964 42 p refs
(Contract DA-36-039-AMC-02204(E))
(SATR-1; AD-453220)

Methods of making new film dielectrics and of improving silicon monoxide used in microcircuitry were studied to increase the dielectric breakdown strength of thin-film capacitors. The use of electron microscope techniques showed that in aluminum electrodes, the surface film was smoother at the edge than in the planar area, and that aluminum crystal size decreased as the edge became thinner. The edge slope of practical electrode thicknesses and mask spacings was about 5° or less, partly due to aluminum atom diffusion on the substrate surface. Electrical leakage of silicon monoxide capacitors showed high sensitivity to deposition rate and some sensitivity to thickness, with deposition rate and thickness interacting in their effect on leakage. Silicon nitride, produced by reactive sputtering of silicon in argon–nitrogen, resulted in dielectric films whose infrared spectra showed an Si—N bond, and also an Si—O bond through contamination. M.G.J.

N65-15697# Naval Ordnance Lab., Corona, Calif. Fuze Dept.
TRANSIENT RADIATION EFFECTS ON ELECTRONICS Interim Report
J. L. Hill 1 Jan. 1964 18 p refs
(NAVWEPS-8177; AD-429358)

Certain missile electronic circuits using Shockley diodes, silicon-controlled switches, and silicon-controlled rectifiers were irradiated to determine the threshold dose rates for transient effects and to evaluate hardening techniques. This effort resulted in the design of firing circuits that cannot be initiated by available test levels of gamma radiation. Author

N65-15737# Knights (James) Co., Sandwich, Ill.
STEP I COMPLETION REPORT FOR TIGHT TOLERANCE MINIATURE CRYSTAL UNITS
Roger E. Bennett and Don C. Schrader Jul. 1964 80 p ref
(Contract DA-36-039-SC-75974)
(AD-608313) OTS: $3.00

Described is the production of 2500 units in the frequency range 4.3 to 20 mc, enclosed in the small metal, HC-18/U, enclosure, and with a maximum frequency deviation from nominal of ±25 parts per million from −55° to +105° C. Yield data are given, and losses are analyzed. Author

N65-15774# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
PLANAR INTEGRATION OF THIN FILM UNITS Third Quarterly Progress Report, 15 Jul.–14 Oct. 1964
M. Lauriente, J. M. Winter, and C. W. Wyble [1964] 30 p refs
(Contract DA-36-039-AMC-03732(E))
(Rept.-3; AD-455010)

Techniques used to fabricate the experimental models are described with the benefit of flow diagrams. Oxidation of aluminum and copper pads due to exposure to air at the curing temperature of the resin required rework of these pads. It was possible to clean the copper pads with a mild etchant, but the aluminum pads had to be metallized with chrome–gold. Some dispersion was observed after deposition of the heavy interconnects extending beyond the width of the mask. Some theories are offered to explain the phenomenon. Adhesion tests were applied successfully to all permutations except reworked aluminum pads on glass. Author

N65-15775 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J. Electronic Components Dept.
EFFECT OF MAGNETIC FIELDS ON MICROWAVE GAS-DISCHARGE DUPLEXER CHARACTERISTICS
Robert M. True and Edward V. Edwards Sep. 1964 49 p ref
(ECOM-2516; AD-609658)

An experimental investigation was made to determine some of the effects of a confining magnetic field on a gaseous plasma within a duplexing device. Both the parallel and crossed E and H field configurations were examined using a helium and a helium–neon Penning mixture gas fill. Temperature measurements indicate that magnetic confinement can lower the rf window temperature of a gaseous discharge duplexing device by more than 50% at pressures below 0.5 torr. Leakage power can also be reduced by 50% or more in this pressure range, but the leakage level in the parallel field device is inherently too high for practical application. Reductions of up to 4.5 to 1 were obtained in the recovery time of helium in the 2 to 50-torr pressure range using a crossed-field configuration. By magnetically confining the plasma discharge of a gaseous duplexer, the performance can be significantly improved by lowering temperatures and gas cleanup rates. Author

N65-15809# Radio Corp. of America, Harrison, N.J. Microwave Tube Operations Dept.
DEVELOPMENT OF A C-BAND TUNNEL-DIODE OSCILLATOR First Quarterly Progress Report, 1 May–31 Jul. 1964
E. Diamond and D. Nelson [1964] 23 p
(Contract DA-28-043-AMC-00088(E))
(Rept.-1; AD-453862)

Several diodes having peak currents of 250 ma and junction capacitances of 8 to 9.5 pF were tested in reentrant strip-line circuits. The rf output powers of 7 and 5 mW were obtained at 4.5 and 5.5 Gc, respectively. The same diodes were tested in coaxial circuits, and 4.5 to 4.8 mW were obtained at 5.0 Gc. It became evident during these tests that 250-mA diodes would be very difficult to load properly since triggering of the oscillators by application of dc voltages was not reliable and the values of output power could not be predicted by theory. Tested were 100 mA diodes in appropriately designed coaxial circuits. The 4.5 to 4.6 mW of rf power were obtained at 5.0 Gc, and reliable triggering was realized. In spite of the fact that experimental results were not yet complete, the rf output was reasonably close to the 5.2 mW predicted by theory. Diodes with peak currents of 150 mA should be a good compromise between power and ease of loading the diode correctly. The final oscillator will consist of a two-diode structure such as that successfully tested in the X-Band contract. Author

N65-15824*# Honeywell, Hopkins, Minn. Ordnance Div.
LOW VOLTAGE DC TO DC CONVERTER-REGULATOR WITH MINIMUM EXTERNAL MAGNETIC FIELD DISTURBANCE Second Quarterly Progress Report, 1 Sep.–30 Nov. 1964
John T. Lingle and K. J. Jenson [1964] 44 p
(Contract NAS5-3899)
(NASA-CR-60397) OTS: HC $2.00/MF $0.50

Efforts were directed toward design optimization, circuit improvement, fabrication of the first coaxial low-input voltage converter-regulator model, and checkout of this model. The coaxial design theoretically produces zero external magnetic fields and should provide minimum external magnetic field disturbance and excellent radio noise interference suppression. Circuit improvements that were incorporated into the model

resulted in an increase in efficiency and an increase in operating frequency. Other advantages afforded by the coaxial converter design and the recent circuit changes include substantial weight and size reduction, heat-transfer improvements, and higher reliability. D.S.G.

N65-15878# Utah U., Salt Lake City. Microwave Device and Physical Electronics Lab.
CYCLOTRON WAVE DEVICES STUDY Fourth Quarterly Progress Report, Apr. 1–Jun. 30, 1964
T. Kao, D. C. Watson, C. H. Durney, C. C. Johnson, and R. W. Grow 30 Jun. 1964 52 p ref
(Contract DA-36-039-AMC-02372(E))
(Rept.-4; AD-451029)

Steps were taken to minimize beam ripple by the use of field shaping and cathode flux variation, but signal gain remained low. Gain and insertion loss were measured at three values of cathode current: 5, 10, and 15 mA. Brillouin-flow current is 20 mA. The rf drive level was varied between 3 Mw and 3W. Beam ripple was measured experimentally by the use of the segmented collector. A new set of beam modes were found analytically, which appear to be Wessel–Berg's force-free modes. The coupling of these modes by the pump field was investigated. Author

N65-15899# Microwave Associates, Inc., Burlington, Mass. Solid-State Circuits Div.
HIGH POWER SEMICONDUCTOR TR DEVICES Fifth Quarterly Progress Report, 1 Jul.–30 Sep. 1964
R. H. Brunton, III [1964] 31 p
(Contract DA-36-039-AMC-03187(E))
(Rept.-5; AD-455065)

Work was performed on both X_L-band and K_U-band phases. Efforts on the X_L portion resulted in the design, fabrication, and evaluation of diode test mounts in WR 112 waveguide; test results are given for these elements with tuning adjusted for various values of Q. These measurements were used to determine the appropriate Q for a three-element preliminary switch design that was evaluated. The efforts in K_U-band were directed toward reducing the overall length of the K_U-band limiter to 0.805 inches. To achieve the reduced length, new and smaller diode mounting stubs were designed; experimental data were obtained for the performance of these structures. New diodes were evaluated to determine appropriate specifications in order to improve the insertion loss and isolation. Author

N65-15916# Microwave Electronics Corp., Palo Alto, Calif.
A THREE-WATT LOW-NOISE TRAVELING-WAVE TUBE FOR C-BAND Interim Development Report, 1 Jul.–30 Sep. 1964
Oct. 1964 17 p
(Contract NObsr-91322)
(IDR-1; AD-608413) OTS: $1.00

Design calculations for the entire vacuum envelope-focusing system were made. Critical long lead time items were ordered, and first experiments with a new and improved technique for helix fabrication, expected to improve overall tube efficiency, were performed. Author

N65-15927# Solid State Radiations, Inc., Los Angeles, Calif.
100 UNIT DETECTOR ARRAY SYSTEM Final Report
Henry S. Katzenstein et al Watertown, Mass., Army Mater. Res. Agency, Mar. 1964 62 p refs
(Contract DA-04-495-ORD-3564)
(AMRA-CR-64-01; AD-451176)

A design study was performed for the fabrication of a 100-detector array and associated electronics to be used in the focal plane of a charge particle spectrometer. The momentum range covered by the spectrometer corresponds to 2-10 MeV for protons and α particles. An energy range of approximately 10% is covered with any given setting of the magnetic field. The object of the array is to display the energy (spatial) distribution of the same particles in the focal plane of the spectrometer on a multichannel analyzer. Discrimination between the particles of different mass is to be obtained in such a way that four different particle masses can be displayed in each of the four quadrants of the analyzer memory. An investigation was performed of the various means by which particles of different mass might be distinguished in the focal plane. Author

N65-15931# Raytheon Co., Waltham, Mass. Research Div.
RESEARCH ON LOW NOISE CATHODE DEVELOPMENT Interim Engineering Report No. 3, Nov. 1, 1963–Jan. 31, 1964
S. R. Steele, W. Getty, S. Mao, and D. Bobroff [1964] 53 p refs
(Contract AF 33(657)-11003)
(S-621; AD-434075)

A vehicle for measuring the effective noise temperature of cathodes was completed, and noise measurements of conventional thermionic cathodes are in progress. Calculations as to the effect of the narrow velocity spread and low beam currents from potential low noise cathodes on gun parameters were made. Guns must be somewhat longer than are currently in use. Some experiments were made using freeze drying as a method for fabricating uniformly dispersed thermionic cathode surfaces. Experiments are being initiated using low-temperature photoelectric cathodes as low noise sources. A theoretical treatment of velocity and density distribution in a simple model of a low noise gun is being carried out with the help of a computer. Author

N65-15958# Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
DESIGN AND DEVELOPMENT INVESTIGATIONS OF A LOW NOISE, LINEAR, VARIABLE GAIN, R.F. AMPLIFIER TUBE Quarterly Progress Report, Jul. 1–Sep. 30, 1964
J. P. Pietrzyk, A. van der Jagt, and R. L. Pear 20 Oct. 1964 66 p
(Contract NObsr-89530)
(QPR-5; AD-608130) OTS: $3.00

An analysis was made of the power-handling capability for the cathode base, interbase, and grid base circuitry of a minimum interference front-end stage for an rf amplifier tube. It was found that the grid base operation should be applied only if the electronic loading is more important than the loading of 1/Gm, and a figure of merit was established. Construction A tubes underwent line life testing, and also shock, vibration, and fatigue testing. Only the life test results were unsatisfactory. The dimensions of the electrodes for the Construction D tube were determined, and their transconductance was defined at about 2700μmhos. The lead inductance measurements for a 9-pin stem configuration were continued. The evaluation of a breadboard for an optimum circuit configuration for the rf amplifier was completed, and the receiver was modified to accommodate the WX4733 tube. G.G.

N65-15985# Little (Arthur D.) Inc., Cambridge, Mass.
METHODS FOR LOW POWER TEMPERATURE CONTROL Final Report, 2 Jul. 1962–29 Feb. 1964

Igor A. Black and John F. Peterson [1964] 124 p
(Contract DA-36-039-SC-90883)
(AD-609093)

The methods and devices by which the temperature of a single quartz crystal blank can be maintained at a constant operating temperature in extreme environmental conditions were investigated. Four types of ovens, in which temperatures are controlled by a snap-action thermostat, were studied: (1) a 500-milliwatt oven (Type E6) requiring accessibility to the crystal and operating at +75° ±2.5° C over a −40° to +60° C ambient; (2) a 50-milliwatt sealed oven (Type F6G) with similar operating requirements; (3) a less costly, 100-milliwatt sealed oven (Type G6G) with similar operating requirements; and (4) a 250-milliwatt oven (Type H6) requiring accessibility to a temperature-compensated crystal and operating at 0° ±3° C over an ambient range from −55° to 0° C. Five ovens of each type were constructed and successfully tested. The amplitude of the crystal operating temperature oscillation, power consumption, and warmup time are within the required limits for the type E6, G6G and H6 ovens. Power consumption of the type F6G ovens is 50% higher than specified. Author

N65-15990# Bendix Corp., Ann Arbor, Mich. Bendix Systems Div.
RADIATION EFFECTS PARAMETERS IN NAP APPLICATIONS Final Report, Jun. 1963–Oct. 1964
R. M. Magee Kirtland AFB, N. Mex., AF Weapons Lab., Nov. 1964 187 p refs
(Contract AF 29(601)-5911)
(BSR-988; WL-TDR-64-97; AD-609302)

The radiation effects caused by different neutron-energy spectra and neutron-to-gamma flux ratios were determined for several silicon transistors. Tests conducted on four planar transistor types (2N709, 2N914, 2N1711, and 2N2894) showed that neutron-to-gamma ratio effects are most significant at low radiation exposures. At these exposures, the damage from gamma radiation may be a significant fraction of the total radiation damage. At higher radiation exposures, neutron effects predominate, and the neutron-spectrum effects may be significant. Calculations of displacement-induced damage showed qualitative but not quantitative agreement with the results of reactor tests. It was also found that other parameters have important effects on the radiation damage observed. In particular, electrical measurement and operating conditions during irradiation can have at least as much effect as do neutron-spectrum or neutron-to-gamma ratio variations. Author

N65-16012# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
DETAILED STUDY OF DELETERIOUS EFFECTS ON SILICON TRANSISTORS Third Quarterly Report, 29 Apr.–28 Jul. 1964
Ki Dong Kang Griffiss AFB, N.Y., RADC, Dec. 1964 54 p refs
(Contract AF 30(602)-3244)
(RADC-TDR-64-436; AD-609994)

A complete summary on common emitter dc gain degradation phenomena on n-p-n transistors is given. The h_{FE} degradation, with respect to nonbias temperature stress, reverse bias plus temperature stress, operating life stress, encapsulating ambient, surface contamination, and surface coating, is discussed. Also, models for h_{FE} degradation are presented. The reasons why the surface sensitive parameters are not closely correlated are discussed. Author

N65-16021# SFD Labs., Inc., Union, N.J.
APPLIED RESEARCH ON EXTENDED INTERACTION ICEM MAGNETRONS Interim Engineering Report No. 3, 16 Oct. 1964–16 Jan. 1965
A. Cook and M. Liscio Jan. 1965 26 p
(Contract AF 33(615)-1570)
(SFD-42-R-3; AD-455676)

Explored is the feasibility of combining two, three, or more Ka-band interaction structures in cascade to produce multiplication of the peak and average power capability of a single tube. Utilizing the basic design of a Ka-band ICEM magnetron, fixed frequency and tunable amplifiers were constructed and tested. Test data obtained by driving single and cascaded amplifiers are detailed. Peak output power in excess of 300 kw was obtained by driving a single amplifier with a magnetron oscillator. Bandwidth and interaction characteristics of the amplifiers in single and cascade operation are discussed. Author

N65-16023# Michigan U., Ann Arbor. Electron Physics Lab.
RESEARCH AND DEVELOPMENT ON HIGH-POWER CRESTATRONS FOR THE 100-300 MC FREQUENCY RANGE Quarterly Progress Report No. 18, 1 Oct. 1964–1 Jan. 1965
G. T. Konrad Jan. 1965 15 p
(Contract NObsr-81403)
(Rept.-03783; AD-455256)

The data obtained in a beam analyzer on a $P_{\mu} = 20$ hollow-beam electron gun are presented. It is shown that the design objectives, which include a beam thickness of 0.080 in. and a mean beam diam of 1.076 in. are essentially met. Two of the final model tubes were built and tested. An ion suppressor ring and a better mechanical contact between the outer conductor of the rf input line and the input matching section are to be incorporated in all the tubes. Author

N65-16044# Radio Corp. of America, Burlington, Mass. Aerospace Communications and Controls Div.
MULTISYSTEM TEST EQUIPMENT Status and Technical Report, 1 Jun.–19 Sep. 1964
J. E. Gallo 21 Oct. 1964 61 p refs
(ATE-MTE-28; AD-450440)

The fabrication and testing of three developmental models for the Multisystem Test Equipment (MTE) are described. The basic mission of the MTE is the performance of fault isolation or identification of suspect units from Army missile systems, and the checkout after repair. The equipment includes two electronic test sets, a hydraulic test set, a pneumatic test set, a repair set, battalion contact support sets, and missile contact support sets. Activities in the following areas of work are summarized: acceptance test support, integration testing of the electronic test set and the hydraulic test set, programing, drawings, documentation of missile interim specifications and technical reports, and system schematics. D.S.G.

N65-16047# Technical Research Group, Inc., Melville, N.Y.
DEVELOPMENT OF A LOW-NOISE MILLIMETER-WAVE PARAMETRIC AMPLIFIER Fifth Quarterly Progress Report, 1 Jul.–1 Oct. 1964
J. Kliphuis, D. Neuf, and B. Albrecht Oct. 1964 25 p
(Contract DA-36-039-AMC-2365(E))
(Rept.-5; AD-455332)

Room temperature impedance measurements made on the surface barrier varactor from 74 to 90 Gc indicate that the diode series resistance increases rapidly with frequency in this band and is also a function of junction bias. A Y-Junction circulator was developed that exhibits a low forward loss (approximately 0.7 dB) from 90.5 to 97 Gc. The ferrite material

used in this circulator is the same as that employed in a previously developed isolator that operated well at liquid-helium temperature. Author

N65-16085# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PULSE INFRARED GENERATORS
Wieslaw Wolinski and Tadeusz Adamowicz 1 Jan. 1965 13 p Transl. into ENGLISH from Przegl. Elektron. (Poland), no. 12, 1963 p 682–690
(FTD-TT-64-925/1+2+3+4; AD-455515)

Reported is the course of research carried out on pulse-type infrared light generators. The results of investigations of three series of low-pressure lamps, filled with argon, krypton, and xenon, and operating in conjunction with an Ag-O-Cs photocathode are presented. Author

N65-16114# Texas Instruments, Inc., Dallas.
LOW-NOISE L-BAND AMPLIFIER Quarterly Progress Report No. 1, 1 Jun.–30 Aug. 1964
L. W. Read, G. D. Johnson, R. R. Webster, and R. L. Petritz [1964] 56 p refs
(Contract DA-28-043-AMC-00109(E))
(TI-03-64-70; AD-609494)

The objectives are to develop satisfactory characterization techniques at microwave frequencies, and to provide data for amplifier design. Terminal Y parameters for L-37 mesa and L-78 planar transistors are presented with an equivalent circuit of the μ-line package used. Errors present in the measured Y parameters are discussed. Some of the error may be caused by poor grounding, but use of a general radio μ-line mount for the transfer function bridge should help solve the problem. Amplitude and phase requirements are discussed and maximally flat amplitude and time-delay responses examined. The L-37 mesa and L-78 planar transistors are evaluated for power gain and stability in the 1.3 Gc region. Using commonly accepted design procedures, only the common base configuration can provide adequate gain at this frequency. Several stripline techniques are described. A polyethylene dielectric with manually cut copper strips is preferable to the silver tape or etched Rexolite. Single and multiple stub filters were developed and should find use as coupling and bandshaping networks in the amplifier. Author

N65-16163# Toronto U. (Canada).
CURRENT AND LOSS DISTRIBUTION IN SOLENOIDS
R. D. Findlay Sep. 1964 77 p refs
(Grant DRB-5596-02)
(RR-35, Pt. I; AD-451434)

This paper examines, from a primarily theoretical approach, a few of the characteristics of power coils. A procedure is developed for analysis of a three-segment coil. Results were experimentally verified and tabulated for equal segments, minimum loss conditions, and variable turns densities. The highly nonlinear nature of coil voltage distribution is demonstrated, and it is shown that a major part of the power loss is attributed to crossfields. Coil design procedures are developed that take voltage distribution and crossfield losses into account. Author

N65-16164# Toronto U. (Canada).
CURRENT AND LOSS DISTRIBUTION IN SOLENOIDS
R. D. Findlay Sep. 1964 92 p refs
(Grant DRB-5596-02)
(RR-35, Pt. II; AD-451249)

This report deals with current and loss distributions in a solenoid. Voltage distribution is found for a segmented coil. The current distribution is then predicted, and finally, the loss distribution is found. Author

N65-16181# Lehigh U., Bethlehem, Pa.
THE PIN DIODE AS A MICROWAVE MODULATOR
Martin Clark Faga (M.S. Thesis) 1964 51 p refs Sponsored by AF
(AD-605437)

Increased use of radio communication has brought use of higher and higher frequencies in the electromagnetic spectrum. While transmission frequencies have risen, intelligible and useful information is still contained in audio and other low frequency signals. Hence modulation, the electronic process of mixing these two signals, is a fundamental part of this development. Unfortunately, modulation methods used with low frequency carrier circuits do not work well, if at all, at microwave carrier frequencies. The PIN diode is a simple semiconductor device whose properties lend it to effective use as a modulator at microwave frequencies. This paper is concerned with a brief theoretical presentation of actual modulating circuits and a discussion of their operation and results obtained. Author

N65-16195# American Monarch Corp., Minneapolis, Minn.
MULTI-STATION PUSH BUTTON SWITCH Interim Development Report, Jul. 1–Sep. 30, 1964
John Weiss 30 Sep. 1964 17 p
(Contract NObs-89440)
(AD-608172) OTS: $1.00

The design work centered about packaging the counterbalanced mechanism into the same size as the previously developed units. A layout was completed, and detail sketching and fabrication of parts was initiated. A three-station unit is to be built for evaluation, after which all parts will be fabricated for the final testing. Author

N65-16297# Hughes Aircraft Co., Newport Beach, Calif. Electronic Products Div.
SSB AND VHF CRYSTAL FILTERS Quarterly Report, 15 Jun.–15 Sep. 1964
E. C. Ho and R. H. Tuznik [1964] 84 p refs
(Contract DA-36-039-AMC-02305(E))
(QR-5; AD-455776)

This report covers the recent work performed on the design and construction of single sideband and vhf crystal filters in the frequency range of 2 to 30 Mc. An equimotional all-pole 10-crystal narrowband filter at 10.5 Mc has been designed and tested; test results and an evaluation are presented. An equimotional and a bimotional 10-pole 10-zero 10-crystal narrowband filter at 10.5 Mc were designed and exactly analyzed under lossy and lossless conditions. The theory, design procedures and schematic diagrams are presented. A bimotional 10-pole 10-zero 10-crystal narrowband ladder filter at 20.0 Mc was designed. Various "normalized" lossless and lossy ladder filter designs have been exactly analyzed and evaluated. At present the ladder filter with single-crystal terminal half-sections appears to be the most feasible design. The first experimental design of the 30-Mc third-overtone crystal filter has been constructed, tested, and evaluated. Test results are presented, and deficiencies and problems with their potential solutions are discussed. Author

N65-16309*# National Aeronautics and Space Administration, Washington, D.C.
ROENTGEN IMPULSE TUBE WITH OPERATING VOLTAGE OF 17 TO 20 kv [IMPUL'SNAYA RENTGENOVSKAYA TRUBKA s RABOCHIM NAPRYAZHENIYEM 17 DO 20 kv]

I. A. Lukatskaya and V. Ya. Tarasova Feb. 1965 11 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), no. 6, 1963 p 124–127
(NASA-TT-F-9254) OTS: HC $1.00/MF $0.50

A description is given of the construction of an impulse roentgen tube with a cold cathode; the tube provides impulses of roentgen radiation having a mean wavelength of 1 Å, with a voltage of 17 to 20 kV on the condenser of a discharge circuit. The tube has a circular cathode and a keep-alive electrode with a gap between them of ≤ 0.1 mm, and a conical tungsten anode. The tube differs from the well-known constructions of this type by the presence of a cylindrical focusing electrode at a potential lower than the cathode, by the presence of an anode having a small diameter, and by simplicity of construction. The first two characteristics make it possible to obtain small focus dimensions (up to 1 mm^2) at a comparatively low operating voltage. The operation of the tube is inspected by X-ray photography of various stages in the process by which the wire explodes. Author

N65-16325# Warnecke Electron Tubes, Inc., Des Plaines, Ill.
RESEARCH AND DEVELOPMENT PROGRAM FOR X-BAND CROSSED-FIELD AMPLIFIER Quarterly Engineering Report, 28 Jun.–12 Sep. 1964
[1964] 49 p refs
(Contract NObsr-89504)
(AD-608849)

It was demonstrated that an X-band line can be made by photoforming on the surface of an insulator. The fenced line (a dissymmetric multiple meander with edges closed) was found to have many advantages, but the rf fields were concentrated at the center, dispersion was excessive for the broadband required here, and transmission losses were too high. A multiple meander open at the edges is used. A saphire support was chosen for the line; the principal disadvantage of ceramics was surface roughness. Work with beryllia ceramics is continuing because the thermal conductivity is important. Studies on other parts of the tube design were undertaken: (1) support of the delay line in a niobium frame; (2) a stepped ridge to couple the delay line to the waveguide and avoidance of coupling to possible fast wave in the interaction space; and (3) a high current density gun with a grid and other design features to reduce excess noise, and with a shield to keep rf energy out of the cathode region. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-15528*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF A BANG-BANG CONTROL SYSTEM TO TWO SPINNING SPACE VEHICLES
Paul S. Rempfer and Jerrold H. Suddath Washington, NASA, Jan. 1965 26 p refs
(NASA-TN-D-2598) OTS: HC $1.00/MF $0.50

A study was made of a technique for the synthesis of bang-bang control systems as applied to the attitude control of spinning space vehicles. Emphasis was placed on studying the details of the technique when applied to a system with component dynamics. Consideration was also given to the handling of limit cycles. The investigation was based primarily on the analog computer simulations of the attitude control of two different spin-stabilized space vehicles. The report includes the development of the switching logic and of a simple cutoff function to eliminate the wasting of fuel in limit cycles. Typical results obtained from computer simulations are included. Author

N65-15532*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FIELD-ENHANCED THERMIONIC EMISSION FROM ELECTRODES OF CESIUM ION THRUSTOR
Joseph F. Wasserbauer Washington, NASA, Jan. 1965 14 p refs
(NASA-TN-D-2635) OTS: HC $1.00/MF $0.50

An analysis is presented to estimate the drain current due to thermionic emission from cesium-coated tantalum accelerator electrodes of an ion thrustor. The effect of electric field strength at the accelerator electrode was included in the analysis. The results of the analysis and the data obtained with an experimental ion thrustor are compared. The ion thrustor was tested at current densities of 58 and 100 A per square meter over a range of accelerating potentials. Good agreement was obtained between the experimental data and the calculated values, based on the assumptions used. Author

N65-15573 Naval Ordnance Lab., Corona, Calif.
NARROW PULSE GENERATION BY NONLINEAR TRANSMISSION LINE METHODS
J. R. Alday *In its* Foundational Res. Proj. 1 Jun. 1963 p 59-76 refs (See N65-15565 06-34)

It was demonstrated theoretically that the dispersional effects due to joule heating and frequency-sensitive transmission line elements degrade the intuitive narrow-pulse-producing capabilities of a lumped-element nonlinear transmission line. However, it is possible, as experiments showed, to generate very narrow pulses at high repetition rates with far less than state-of-the-art components, if the dispersional effects are small over the range of the forcing frequency and its highest order harmonic. D.E.W.

N65-15764# Stanford Research Inst., Menlo Park, Calif.
SYMMETRIC PSD METHODS FOR A CLASS OF NONSTATIONARY STOCHASTIC PROCESSES
Richard C. Singleton Oct. 1964 95 p refs
(Contract ARPA SD-103; ARPA Order 281-62)
(TR-23; AD-451782)

This report considers three symmetric power spectral density (PSD) analysis methods, methods in which the estimated PSD function does not change if the labeled direction of time increase is reversed. Two of these symmetric methods are shown to be well suited to analysis of a nonstationary stochastic process with changing frequency. Author

N65-15806# Radio Corp. of America, Princeton, N.J. RCA Labs.
THEORY OF ADJUSTABLE SWITCHING NETWORKS Special Scientific Report No. 4, 1963–1964
K. R. Kaplan, C. V. Srinivasan, and R. O. Winder 30 Oct. 1964 61 p refs
(Contract AF 19(604)-8423)
(AFCRL-64-893; AD-609745)

This report consists of four independent sections. (1) *Chebyshev Approximation and Threshold Functions* provides, among other things, a new characterization of threshold functions—a function is a threshold function if and only if its

Chebyshev-best linear real approximation realizes it. (2) *Properties of Threshold Functions* defines a system of unifying properties of threshold functions that incorporate k-monotonicities and k-dual-monotonicities; the ideas are applied to yield a strong and important new characterization of threshold functions for specific n. (3) *On Threshold Functions Through n = 7* reports the methods used in, and implications of, an enumeration published elsewhere. (4) *A Burst Error-Correcting Code* discusses a new code, suitable for use in batch-fabricated memories that requires extremely simple encoding–decoding equipment. Author

N65-15932# Stanford Research Inst., Menlo Park, Calif.
MODES OF NEURISTOR PROPAGATION—A STUDY IN DISTRIBUTED ACTIVE PROCESSES Final Report
Milton W. Green and Hewitt D. Crane Sep. 1964 103 p refs
(Contract Nonr-3212(00))
(AD-608148) OTS: $4.00

This report attempts to connect a variety of observations on neuristor and neural structure into one framework based largely on a simplified model representation of a neuristor device. This model, consisting of a linear RC transmission line with distributed shunt negative conductance processes, was selected because it is sufficiently simple to permit formal mathematical analysis and yet adequately complex to display many of the features of neuristor behavior. Negative conductance elements of the type that can be employed in the modeling of a neuristor line are discussed, together with questions relating to realizability, switching speed, and stability of individual elements and their distributed versions. Mathematical descriptions of diffusion-type (RC) lines employing shunt active processes are given. A computer simulation procedure is presented in which are developed some criteria to be observed in obtaining accurate solutions when lumped-line representations are used to approximate smoothly distributed line parameters. Author

N65-16010# Sperry Gyroscope Co., Great Neck, N.Y. Radiation Div.
TRANSIENT BEHAVIOR OF LARGE ARRAYS Technical Documentary Report, 1 Mar.–30 Jun. 1964
G. F. Ross, J. Hanley, L. Susman, and A. S. Ferello Griffiss AFB, N.Y., RADC, Dec. 1964. 143 p refs
(Contract AF 30(602)-3348)
(RADC-TDR-64-348; EB-5287-0500-1; AD-610074)

This report contains the results of a theoretical and experimental investigation into the transient response of microwave components used in feed networks of large antenna array systems. The concepts commonly used in linear lumped network theory are applied to the transient behavior of distributed networks. In particular, it was found that for TEM mode components a network characterization in the complex z-plane (that is, $z = e^{-pT}$, where p is the complex frequency variable, $p = \sigma + j\omega$) enables closed form solutions to be obtained from which the frequency response and transient behavior can be found. Flow graph techniques are applied to the analysis of TEM mode components, such as couplers, ring hybrids, power dividers, phase shifters, etc. and theoretical results for the impulse, step, and modulated step responses as well as the amplitude spectrums and phase functions are presented. Experimental results of test on uhf and L-band components that verify the theoretical results are presented. The results were obtained by using newly developed techniques for generating pulses of approximately 0.2 nsec in duration and high frequency sampling oscilloscope displays. Author

N65-16080*# General Electric Co., Daytona Beach, Fla. Electronic Simulation Unit
ELECTRONIC SYSTEM EVALUATION, PHASE B, PART III Completion Report
E. L. Berger, J. C. Jackson, and R. A. Luoma 15 Jan. 1965 65 p refs *Its* Rept.-65-SIMAR-68/7
(Contract NAS8-11715)
(NASA-CR-60481) OTS: HC $3.00/MF $0.75

The main objective of single parameter testing was to put into operation better ways of testing components during stage checkout. Conclusions reached include: (1) Linear active networks can be interpreted as linear system transfer functions with limited input signal amplitudes. (2) The ability to measure variations in coefficients of general first-order and second-order transfer functions can be demonstrated experimentally. (3) Nonlinear properties in coefficients of active networks may be ignored if the signal amplitude can be limited to the linear region. (4) Simultaneous variation in many parameters may require longer testing routines to establish the values of each parameter variation. (5) Noisy signal degradation in the measuring process is independent of the complexity of the system. (6) Absolute measurement accuracy is a function of system complexity. (7) Complicated transfer functions can be reduced by a difference or a compensation technique. R.E.S.

N65-16238# California U., Berkeley. Electronics Research Lab.
CONSOLIDATED QUARTERLY PROGRESS REPORT NO. 11
15 Nov. 1963 119 p refs
(Contracts AF 19(628)-324; DA-36-039-AMC-02164(E); Nonr-222(53); Grants AF-AFOSR-139-63; NSF G-15965 etal)
(AD-425961)

Work was performed in the major areas of: *Circuits; Computer Theory and Programing*—new input–output subroutines for an ALGOL system; *Electron Streams and Interactions; Plasmas; Radiation and Propagation; Solid State Electronics;* and *Systems*—operational methods in optimal system theory, noise filtering by a neutral pulse frequency modulator, and applications of mathematical programing to information theory. Also included is a description of a digital simulation model of a portion of the bat auditory system. G.G.

N65-16246# Naval Postgraduate School, Monterey, Calif.
LINEAR CONTROL SYSTEM OPTIMIZATION USING A MODEL-BASED INDEX OF PERFORMANCE
James S. Demetry and Harold A. Titus Nov. 1964 58 p refs
(RP-48; AD-608458)

This paper deals with a method of optimizing the free coefficients in the characteristic equation of a linear feedback control system. The optimization is carried out by minimizing an index of performance associated with the system's response to a given test disturbance. The index of performance is the integral of a quadratic function of the system state variables. The structure of the index rests upon a logical interpretation of the regulator nature of the control problem. The index for an nth order system contains n weighting factors whose values are determined from an nth order model system. This determination is such that the optimization of a completely free system will yield the model system. A system with fewer than n degrees of freedom in the state variable feedbacks may be optimized with respect to the free feedback coefficients, yielding a system whose dynamic response to a given disturbance is, for this optimization scheme, a best approximation to that of the model. Examples are presented for illustration of the salient features of the method. It is also shown that systems with closed-loop zeros may be optimized by this method. Author

N65-16268*# Tennessee U., Knoxville.
DESIGN OF TIME WEIGHTED MINIMUM ENERGY DISCRETE-DATA CONTROL SYSTEMS Scientific Report No. 8
A. M. Revington and J. C. Hung 1 Feb. 1965 18 p refs
(Grant NsG-351)
(NASA-CR-60512) OTS: HC $1.00/MF $0.50

A procedure is developed for designing the time-weighted minimal energy control of an nth order plant. It is desired to take the state of the plant from some initial state to some required final state in N sampling periods, with $N > n$, while minimizing a time-weighted cost function of the controlling energy. This cost function stresses the controlling action of any part of the input sequence and relegates the remainder of the sequence to a supporting role. The control sequence is found in a straightforward manner, depending only on a useful matrix called the derived matrix. A detailed example shows how this matrix is utilized and demonstrates the advantages of this time weighted minimal energy control sequence. Author

N65-16313*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANALYSIS OF NOTCH NETWORKS CONTAINING SYNCHRONOUSLY COMMUTATED CAPACITORS OR RC COMBINATIONS
Bernard A. Asner, Jr. Washington, NASA, Feb. 1965 83 p refs
(NASA-TN-D-2625) OTS: HC $3.00/MF $0.75

An extensive study is made of systems of differential equations that describe an adaptive tracking notch filter. The two basic networks considered are the coupled RC and the uncoupled RC commutated networks. The coupled network leads to differential equations with time varying coefficents of a square wave nature; the other leads to a set of linear differential equations with periodic forcing functions. For the latter case, a frequency response function in closed form is obtained using complex convolution. In both cases, explicit solutions are obtained by introducing jump functions. Time responses of actual networks are included to show the agreement with the theoretical analysis. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-15462 White Sands Missile Range, N. Mex. Range Instrumentation Systems Office
ADDITIONAL ANALYSIS OF MISSILE TRAJECTORY MEASURING SYSTEMS
Oliver L. Kingsley and Bernie R. Free *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 241-254 refs (See N65-15451 06-19)

Four flight tests were conducted for the study of accuracy and precision of missile trajectory measuring systems. A summary of the results of the third flight test is presented and compared to the results of the first two. The four tracking systems used were: the ballistic camera, which photographs a flashing light on the missile against a star-trail background; the Askania cinetheodolite, a tracking camera which photographs the missile along with internal dials showing azimuth and elevation angles of the optical axis for each frame of film; DOVAP, which is a continuous wave electronic system using the doppler principle to determine position data; and the FPS-16 radar, which measures range and azimuth and elevation angles. It was concluded that the DOVAP was the most precise trajectory measuring system, and the ballistic camera system was the second most precise system; and that system bias needs to be reduced in the remaining two systems. D.S.G.

N65-15589*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIENCES IN SIMULATING THE SPACE ENVIRONMENT FOR SCIENTIFIC SATELLITES
John C. New Jul. 1964 25 p refs Presented at the 1st Intern. Congr. on Vacuum Tech. in Space Res., Paris, 1 Jul. 1964
(NASA-TM-X-55120; X-320-64-361) OTS: HC $1.00/MF $0.50

The experiences in creating the space environment under laboratory restraints are discussed. It was determined that exact duplication of the total space environment is neither technically nor economically feasible. However, operation of the complete spacecraft system under simulated space environments has proved highly effective in detecting correctable problems on both prototype and flight units. Satellites tested in this manner have been very successful in space. The limitations in recreating the space environment are of particular importance to the correct understanding of the technological problems involved not only in the spacecraft but also in the environment simulator. Author

N65-15603# Science and Technology Agency, Tokyo (Japan).
SPACE IN JAPAN
Shohei Tatebayashi, ed. 1964 137 p

A general survey of the space science technology effort in Japan is presented. The main subjects discussed are developments in satellite and meteorological sounding rocket design and manufacturing, the establishment of an overall, long-range rocket manufacturing plan, the utilization of space through orbiting satellites, the promotion of space science through the use of sounding rockets, and the development of various observation and measuring devices for rockets and satellites. G.G.

N65-15633# Illinois U., Urbana.
THE UNIVERSITY OF ILLINOIS RADIO TELESCOPE Progress Report, 1 Jul.–30 Sep. 1964
G. C. Mc Vittie and G. W. Swenson, Jr. 10 Nov. 1964 9 p
(Contract Nonr-1834(22))
(PR-21; AD-608159) OTS: $1.00

Work is reported on the maintenance, land acquisition, and financing of the Vermilion River Observatory 400-ft radio telescope, and on the associated electronic systems and equipment. Observations with the radio telescope over a 10-month period were assembled into a catalog that gives the positions and intensities of 181 radio sources at a frequency of 610.5 Mc/sec. The confusion limit of the instrument was shown to be 0.7 flux units, which corresponds to 60 sources per beam solid angle. The lower limit of the survey was established as 0.8 flux units. The region surveyed covered declinations +40° to +42° and right ascensions from 21^h through 0^h to 19^h and also from +42° to +44° in declination and 10^h to 19^h in right ascension. The beginning of a program of observations of the Cygnus Y region is discussed. D.E.W.

N65-15689# Naval Ordnance Test Station, Pasadena, Calif. Underwater Ordnance Dept.
YFU-44 DEEP DEPTH TEST FACILITY
D. A. Kunz Nov. 1964 20 p
(NOTS-TP-3561; AD-609823)

The Deep Test Facility is a converted LCU, equipped and instrumented for underwater torpedo launchings and transducer tests, and for studying ocean and target acoustic phenomena. A submersible frame, lowered through a well in the ship, permits underwater testing at any depth down to 600 ft. An air-conditioned, humidity-controlled instrumentation room contains the triaxis mount module control rack and mount servoamplifiers, the central communications control center, the photodata panel and its analog-to-digital system, and additional recording systems and test equipment. The vessel, with a cruising speed of 5 knots, can be operated anywhere in the 476-sq-mile sea area of the Long Beach Sea Range. M.G.J.

N65-15690# Naval Ordnance Test Station, Pasadena, Calif. Underwater Ordnance Dept.
LONG BEACH SEA RANGE
D. A. Kuntz Nov. 1964 20 p refs
(NOTS-TP-3562; AD-609824)

The facilities available at the Long Beach Sea Range for the development testing and evaluation of underwater ordnance systems include: (1) shore facilities—sea range operations center, photographic and electronics laboratories, communications repair and machine shops, torpedo assembly and environmental test areas, and the Naval Command Center; (2) shipboard facilities—target boats for simulating target echoes in torpedo testing; patrol boats for patrol, supply, and transport functions; tug boats for underwater search, oceanography studies, target boat duties, and towing operations; and special purpose vessels for torpedo launching, captive torpedo testing, and other assignments; (3) Deep Depth Test Facility—a converted LCU with a submersible test mount that can be stabilized in three axes during underwater tests. M.G.J.

N65-15698# Naval Radiological Defense Lab., San Francisco, Calif.
A PRELIMINARY OPTIMIZATION TECHNIQUE FOR DETERMINING THE EARLIEST RADIOLOGICAL RECOVERY TIME FOR AN INDUSTRIAL OR MILITARY FACILITY
L Minvielle 6 Oct. 1964 41 p. refs
(Contract CDM-SR-59-54)
(USNRDL-TR-788; AD-452954)

In the event of a nuclear attack on the United States certain vital areas would be contaminated by radioactive fallout. It may be essential to resume operations in some of these areas with a minimum of delay. This report presents a technique based on optimization methods by which the earliest possible entry time can be determined subject to the condition that the doses accumulated by the recovery personnel do not exceed certain prescribed dose limitations. It also presents the most basic concepts of the method and illustrates the fundamental aspects of the solution by a simple example solved graphically. Before practical numerical answers can be obtained, further theoretical work may be required; additional experimental and operational data are also needed. Author

N65-15749*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CHARACTERISTICS OF A CONTINUOUS-FLOW INDUCTION PLASMA ACCELERATOR
J. D. Brooks, W. D. Beasley, and R. L. Barger Washington, NASA, Feb. 1965 30 p refs
(NASA-TR-R-219) OTS: HC $2.00/MF $0.50

Characteristics of continuous-flow induction plasma accelerators with a 10-kc, single-phase driving coil on supersonic nozzles were studied. Pressure measurements and vane-deflection measurements were made in a 15-cm-diam accelerator at various mass flow rates. Charged-particle velocities were obtained in 15-cm-diam and 10-cm-diam accelerators by measuring with photoelectric detectors the time required for a change in flow luminosity to travel a known distance. Pressure-probe measurements indicated that the entire flow, including the boundary-layer and the separated-flow region, was accelerated in the 15-cm-diam accelerator. The largest increase in pitot pressure was 250% of the cold-flow value with 20 kW of 10-kc driving power. The charged-particle velocities increased as the mass flow rate was reduced and as the power was increased. The maximum charged-particle velocity obtained was 40 000 mps in the 10-cm-diam accelerator. Average velocity and thrust obtained from vane-deflection measurements were in good agreement with those obtained from pressure-probe measurements. Author

N65-15816*# General Electric Co., Philadelphia, Pa. Spacecraft Dept.
A STUDY OF SPACECRAFT TESTING PHILOSOPHIES AND TECHNIQUES Final Report
23 Nov. 1964 311 p refs Prepared for JPL *Its* Rept.-64SD4370
(Contract JPL-950830)
(NASA-CR-60410) OTS: HC $7.00/MF $1.75

The Mariner C, with the addition of a lander and a surviving capsule, was used as the basic study vehicle with regard to design approach, relative complexity, and method of construction. A Mars mission was used as the typical mission, an estimate of the possible environments from the assembly of the spacecraft through completion of the mission was made, the system test functions of many different parts and subassemblies were summarized, and a concept for estimating risk with regard to spares was formulated. Appendixes contain a failure mode analysis, statistical tables, derivation and sample calculations, a summary of previous applications, a sample interference control plan, and a Mariner B entry vehicle study. G.G.

N65-15821*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-30, VOLUME IV FOR THE PERIOD OCTOBER 1, 1964 TO NOVEMBER 30, 1964. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
31 Dec. 1964 289 p refs
(Contract NAS7-100)
(NASA-CR-60401; JPL-SPS-37-30, Vol. IV) OTS: HC $6.00/MF $1.50

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21. PARTS RELIABILITY J. Visser et al p 279–281

N65-15827# California U., Berkeley. Lawrence Radiation Lab.
APPARATUS FOR MOLECULAR BEAM STUDIES OF CHEMICAL DYNAMICS
Kent Raymond Wilson 15 Aug. 1964 137 p refs
(Contract W-7405-ENG-48)
(UCRL-11605) OTS: $4.00

A detailed description of an apparatus for studies of elastic and reactive scattering of thermal energy molecular beams is presented. This modified crossed-beam machine, Big Bertha, contains a new detection massfilter and is adaptable to either surface or electron-bombardment ionization. Experiments are performed by crossing two beams of molecules and observing the direction in which the molecules emerge from the intersection. The elastic scattering is given by the angular distribution of the molecules of one beam which are deflected by the collision, and the chemical reactive scattering is given by the angular distribution of the formed product molecules. The emerging molecules are measured with a massfilter detection system after undergoing differentiating surface ionization. An outline of the experimental procedure and the massfilter detection is presented, and a modulated beam system to reduce the noise in the molecular beam experiments is described. G.G.

N65-15832# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE HAYSTACK EXPERIMENTAL FACILITY Technical Report No. 365
H. G. Weiss 15 Sep. 1964 62 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-378; AD-608272)

A new ground station for space communications, radar, and radio astronomy research was completed, which employs a 120-foot-diameter fully steerable antenna enclosed in a metal space-frame radome. Advanced design and construction techniques were developed to achieve a reflector with a very precise parabolic contour. The antenna will operate very efficiently at wavelengths of 3 cm and will also provide a useful capability at wavelengths as short as 8 mm. At the highest operating frequency, the half-power width of the antenna beam will be less than 0.02°. To provide appropriate control for this very narrow antenna beam, a general-purpose digital computer was integrated into the facility. The rf configuration of the antenna is compatible with the use of high-power transmitters and cooled, low-noise receiving equipment. Author

N65-15892*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
VACUUM SYSTEM SIMULATION AND MULTIPORT SYSTEM FEASIBILITY STUDY
C. T. Egger and J. B. Gayle 8 Dec. 1964 30 p ref
(NASA-TM-X-53175) OTS: HC $2.00/MF $0.50

The pumpdown, degassing, and ultimate vacuum characteristics of single and multiport vacuum systems under various operating conditions are compared by means of a mathematical model and electrical analog computer simulation. Using this technique, it was shown that a large multiport vacuum system employing a large diffusion pump is feasible and affords a number of advantages not attainable in an array of individual single-chamber systems of nominally similar capabilities. Experimental data for an existing single-chamber laboratory system are in close agreement with performance characteristics predicted by the simulation method. Author

N65-15907# California U., Livermore. Lawrence Radiation Lab.
HAZARDS CONTROL Quarterly Report No. 18, Jul.–Sep. 1964
J. J. Cohen et al [1964] 65 p refs
(Contract W-7405-ENG-48)
(UCRL-12167) OTS: $3.00

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7. USE OF DIFFUSION COEFFICIENT MEASUREMENTS FOR PHASE DEFINITION OF RADIOIODINE AEROSOLS C. L. Lindeken p 29–33 refs
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11. EVALUATION AND TESTING OF A REMOTELY OPERATED EXPLOSIVE-ATMOSPHERE METER J. R. Gaskill and R. L. Shaw p 49–54

12. WEATHERING AND LIGHT-TRAFFIC EFFECTS ON SIDE-WALK TEST PATCHES J. R. Gaskill and C. R. Veith p 55–58

N65-15920# ARO, Inc., Arnold Air Force Station, Tenn.
SHADOWGRAPH FLOW VISUALIZATION FOR THE 16-FOOT SUPERSONIC WIND TUNNEL
James D. Bratcher and James E. Eldridge Arnold Eng. Develop. Center, Nov. 1964 26 p refs Presented at the 22d Supersonic Tunnel Assoc. Meeting, von Karman Inst. for Fluid Dyn., Rhode-Saint-Genèse, Belgium, 24–25 Sep. 1964
(Contract AF 40(600)-1000)
(AEDC-TDR-64-232; AD-450967)

A shadowgraph system was developed to allow limited flow visualization in a 16-ft supersonic tunnel. Arrangement and coverage of the system are demonstrated. A brief description of the equipment is included, along with the theory of operation of the system. Author

N65-15938# Air Force Systems Command, Andrews AFB, Md. Office of the Staff Meteorologist
NATURAL ENVIRONMENTAL DATA AND SUPPORT REQUIREMENTS
1 Aug. 1964 144 p refs
(AFSC-TDR-64-2; AD-451331)

Each of the systems divisions and test centers was requested to comment on needs for natural environmental information in terms of areas of environmental parameters, kind of data used, adequacy or inadequacy of the data, programs or systems which require the data, future data requirements, and accuracies required. The reports were divided into three groups: Group I includes those atmospheric parameters that have long been of concern in classical meteorology and are now of interest to great distances from the earth's surface; Group II, atmospheric parameters important in near-earth phenomena which have recently become of concern, such as micrometeorological diffusion or acoustical propagation properties; and Group III, space parameters characteristic of the interplanetary medium as meteorites charged particles, etc. Each report describes the parameters, the current state of knowledge, and the current and future requirements for information. R.E.S.

N65-16113# Federal Aviation Agency, Atlantic City, N.J. Evaluation Div.
EVALUATION OF AUTOMATIC TERMINAL INFORMATION SERVICE APPLICATIONS Final Report
Enoch H. Wright Sep. 1964 66p refs
(RD-64-135; AD-608806)

Applications of automatic terminal information service were evaluated at several types of terminal areas using varied procedures and radio facilities to broadcast the information. It was concluded that, although interference problems may exist in some locations, the VOR test facilities, modified with a voice channel and increased output power was a satisfactory method of transmitting a combined arrival and departure automatic terminal information service message, resulting in reduced controller workload and radiofrequency congestion. Use of a navigation facility voice channel precluded the use of such a facility for weather broadcast and ground–air communications at some locations. Sequential transmission of automatic terminal information service messages for two or more airports over the same voice channel was unsatisfactory. The use of a discrete frequency was a satisfactory method of transmitting combined arrival and departure messages. Author

N65-16149# ARO, Inc., Arnold Air Force Station, Tenn.
AN EXPERIMENTAL INVESTIGATION IN A MODEL TUNNEL TO DETERMINE THE STARTING AND RUNNING PRESSURE RATIO REQUIREMENTS OF THE PWT 16-FOOT SUPERSONIC TUNNEL AT M = 3.5 TO 6.0
F. M. Jackson and P. F. Blanchard Arnold Eng. Develop Center, Nov. 1964 46 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-240; AD-451306)

A determination of the minimum pressure ratios necessary for starting and running in the PWT, Supersonic (16S) was required in the Mach number range from 3.5 to 6.0. Estimates of these requirements were determined by tests in the AWT, Supersonic (1S) model tunnel. For these tests the variable geometry diffuser contained a closed-off scoop, and a model was installed in the test section. The results of these tests indicate that for Tunnel 16S the minimum starting pressure ratio requirements vary from 58% normal shock recovery at $M_\infty = 3.50$ to 45% at $M_\infty = 5.85$. The minimum running requirements vary from 112% normal shock recovery at $M_\infty = 3.50$ to 85% at $M_\infty = 5.85$. Author

N65-16226# Advisory Group for Aeronautical Research and Development, Paris (France).
INDEX TO AGARD PUBLICATIONS, 1952–1963
A. G. Vannucci and J. C. Dunne comp. (Min. of Aviation) [1963] 452 p refs

This revised index of 2161 items includes all the material in the 1952 to 1962 index, together with details of papers published in 1963 and some items from 1964 publications. Included are a subject index, an author index, and a report number and publication number index. In most cases, an abstract is also presented. G.G.

N65-16263*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MATHEMATICAL MODELS OF MISSILE LAUNCHING, PART III
Alfred C. Dahlgren 21 Aug. 1964 13 p refs
(Contract NAS7-100)
(NASA-CR-60506; JPL-TR-32-655, Pt. III) OTS: HC $1.00/MF $0.50

By means of a mathematical model of the situation, including assumptions about the nature of the delays encountered, an estimate is presented of the expected number of days required to launch four missiles from two pads, allowing no simultaneous (i.e., same-day) countdowns or launches. Author

N65-16279# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
AUTOMATIC MODEL ATTITUDE SYSTEM 8-FOOT TRANSONIC WIND TUNNEL
Dec. 1964 18 p Revised
(WTO-498)

A general description of a model attitude system for a transonic wind tunnel is given, and its operational procedures

are discussed. The system contains hydraulically operated and remote controlled mechanical units for model attitude settings of pitch, yaw and/or roll, and can be operated manually or automatically. G.G.

N65-16285# Denver Research Inst., Colo. Mechanics Div.
ELECTRICAL AUGMENTATION OF A LIGHT GAS GUN
William G. Howell and James P. Kottenstette Arnold AF Sta., Tenn., Arnold Eng. Develop. Center, Jan. 1965 56 p refs (Contract AF 40(600)-1024)
(AEDC-TR-65-32; AD-455811)

This report covers the experimental and analytical research directed toward the development of a system for electrical augmentation of a light gas launcher. The first phase involved the use of a medium performance light gas launcher to develop techniques and prove that electrical augmentation was experimentally practical. The second phase used a high performance launcher to attempt optimization of these augmentation techniques. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-15463 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ASPECTS TO CONTROL LIQUID PROPELLANT SLOSHING BASED UPON EXISTING THEORY
W. R. Eulitz *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 256-285 refs (See N65-15451 06-19)

During the last decade, many attempts were made to ascribe the response of a liquid to exciting oscillations. Although principally a nonlinear problem, the theory was confined to the first-order terms only, due to mathematical difficulties. This linearized theory was discerned in satisfactory agreement with many experimental results, at least as far as the first liquid resonance is concerned, which likewise is the most adverse condition for the vehicle controls system. The interpretation of the existing theory leads to dimensionless parameters which, incorporated in a nomograph, provide quick orientation on liquid behavior under varying oscillatory conditions. Such data help to define critical vehicle flight periods and to predetermine proper design parameters. The survey of the parameters of oscillatory liquid motion suggests possible means of suppressing liquid sloshing. The pros and cons of several methods are discussed, and furthermore, the prospects for proper measurements of liquid surface motion are indicated. Author

N65-15464 Army Missile Command, Huntsville, Ala. Structures and Mechanics Lab.
BASIC CONSIDERATIONS FOR THE PRELIMINARY DESIGN OF A SHOCK TUBE FOR THE INVESTIGATION OF THE ACTION OF A NUCLEAR EXPLOSION WAVE UPON A MISSILE
Dietrich E. Gudzent *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 287-305 refs (See N65-15451 06-19)

After a brief survey of the phenomena following a nuclear detonation in the atmosphere, an expression for the shock front velocity as a function of the peak overpressure, and a plot of the reflected overpressure ratio as a function of angle of incidence of the shock front are presented. Elementary shock tube theory is reviewed, and graphs showing the variation of the shock Mach number and particle velocity as functions of diaphragm pressure ratio are given for the gas combinations air–air, helium–air, and hydrogen–air. Specific conditions of a nuclear explosion to be simulated by the shock tube and the resultant design criteria are discussed. D.S.G.

N65-15511 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN CASES OF CALCULATION OF THE NORMAL POSITIVE DISCHARGE WAVE
E. P. Kovalenko *In its* Trans. of Power Eng. 10 Sep. 1964 p 187-207b refs (See N65-15509 06-33)

With the development of contemporary hydraulic engineering construction leading toward cascaded installations, there is a necessity for a relationship between cascaded hydraulic stations and a determination of transit time and distribution of flow rates of a wave moving from a higher reservoir to a lower reservoir. This report presents a method for the calculation of certain cases of motion of a normal positive discharge wave in a natural bed. Calculations take into consideration the motion of the wave, the length of the wave head, and the speed of the wave front. Mathematical formulas are developed for the process of flood wave propagation in a rectangular bed with a uniform grade, and with a corresponding velocity for each depth. Examples of calculation for positive flood waves superimposed on negative waves, and of flood wave motion in the case of wave passage over a stabilized flow, are presented. The conclusions reached are: (1) The normal positive flood wave can be calculated. (2) The method makes it possible to calculate the nonsteady motion with satisfactory accuracy with given curves of relationship $w = f(Q)$. (3) The method requires elaboration in regard to study of the influence of tributaries, drainage, and variations in slope over segments. R.E.S.

N65-15550# Picatinny Arsenal, Dover, N.J. Engineering Sciences Lab.
SUPERSONIC FLOW ABOUT RIGHT CIRCULAR CONES AT ZERO YAW IN AIR AT THERMODYNAMIC EQUILIBRIUM. PART III: TABLES OF DATA, CONTINUED
Henry E. Hudgins, Jr. Sep. 1964 817 p
(PA-TM-1493; AD-451469)

Presented are the cone flow properties of air in chemical equilibrium for altitudes from 100 000 to 200 000 ft at cone angles of 2.5° to 50°, and various Mach numbers from 3.0 to 40.0. Also discussed are the cone properties for altitudes from sea level to 80 000 ft. An analysis and correlation of this data are given. The table of symbols was reproduced in this report for the convenience of the reader. Author

N65-15557# Aberdeen Proving Ground, Md. Exterior Ballistics Lab.
GROWTH OF THE TURBULENT INNER WAKE BEHIND LARGE SPHERES AT SUPERSONIC VELOCITIES
Walter F. Braun Sep. 1964 29 p refs
(BRL-MR-1597; AD-453850)

Experimental data are presented on the growth of the envelope of the turbulent inner wakes up to 3000 calibers behind 9/16-, 3/4-, and 2-in. spheres traveling at supersonic

velocities. A description of the experimental technique and a discussion of its limitations for obtaining adequate data are given. Data are fitted to the equation $r^3 - bx_e = c$, and the growth of the far wake is compared with theoretical predictions. Values of C_D are computed using the coefficient b from this equation in the expression $b = 1.85\ KC_D$. Since there exists an aperiodic development of the wake envelope and since the small sample size of the data may bias the determination of the growth rate, the data from all available rounds were averaged to obtain values of C_D. Author

N65-15626*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

BEHAVIOR OF LIQUID-VAPOR INTERFACE OR CRYOGENIC LIQUIDS DURING WEIGHTLESSNESS

Clifford E. Siegert, Donald A. Petrash, and Edward W. Otto Washington, NASA, Feb. 1965 13 p refs

(NASA-TN-D-2658) OTS: HC $1.00/MF $0.50

An experimental study was conducted to determine the behavior of liquid nitrogen and liquid hydrogen in spherical and cylindrical tanks after entering a weightless environment. The results of this study revealed that the configuration of the liquid–vapor interface in spherical tanks for both liquids was a totally wetted tank wall typical of liquids with a 0° contact angle. Also, the configuration of the liquid–vapor interface of nitrogen in a cylindrical tank was a surface of constant curvature with a radius equal to the radius of the cylindrical tank. A determination of the time required for the liquid–vapor interface to reach equilibrium resulted in an extension of the Weber number scaling parameter to include the cryogenic liquids. Author

N65-15646# General Applied Science Labs., Inc., Westbury, N.Y.

AN APPROXIMATE ANALYSIS OF THE CONTINUUM LOW DENSITY HYPERSONIC FLOW OF A CHEMICALLY REACTING AND RADIATING GAS OVER A BLUNT NOSED BODY

Massimo Trella and Roberto Vaglio-Laurin 26 Oct. 1964 38 p refs

(Contract ARPA-SD-149; ARPA Order 396)

(TR-414; AD-451726)

The continuum low-density hypersonic flow of a chemically reacting and radiating gas over a blunt body was analyzed by an approximate technique based on a recent alternative formulation of the well-known method of integral relations. Specifically, approximations are introduced for the streamwise variations of several flow properties, while detailed radial profiles, (consistent with the stipulated procedure) are sought by numerical analysis along normals to the body (essentially normals to streamlines); the particular formulation allows careful analysis of the large changes in physicochemical properties of the gas between body and shock, as are to be encountered at the low Reynolds numbers where viscous effects are important over the entire shock layer. Detailed derivations of the simplified system of ordinary differential equations and of the boundary conditions governing the problem are presented. Author

N65-15658# Aeronautical Research Associates of Princeton, Inc., N.J.

AN EXPERIMENTAL STUDY OF TURBULENCE IN A DRIVEN VORTEX

Coleman duP. Donaldson and Guy G. Williamson Jul. 1964 44 p refs

(Contract AF 49(638)-1187)

(ARAP-TM-64-2; AFOSR-64-1924; AD-609480)

Measurements were made at two rotational speeds of the mean motion and turbulence levels within a shallow vortex chamber that has a rotating porous wall as an outer boundary. Very nominal levels of turbulence (2% to 3%) were observed on the central plane of these vortices, while a significant portion of the mass flow through the vortex was observed to pass through the end wall boundary layers. A fairly high level of turbulence was then introduced into this vortex chamber by means of a grid of axially aligned bars at the outer rim of the vortex. The results obtained corroborate Kendall's findings, namely that the primary cause of the degradation of the performance of a confined vortex is the leakage of mass flux through the boundary layers on the end walls of the vortex chamber. Author

N65-15661# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.

RAREFIED FLOW TRANSITION AT A LEADING EDGE

Y. S. Pan and Ronald F. Probstein Oct. 1964 90 p refs

(Contract Nonr-1841(93))

(Publ.-64-8; AD-608431)

Rarefied flow near the leading edge of a flat plate was studied by using the Navier–Stokes equations as a model. By considering the structure of an oblique shock wave, new low-density jump conditions were obtained that include the effects of inviscid curvature, thickness, and transport behind the shock. The latter effect leads to the concept of a "velocity slip" (and temperature jump) behind a shock, analogous to that prevailing at a solid surface in a low density flow. The equations governing the viscous layer itself were formulated, including the effect of normal pressure gradient, and were reduced to ordinary differential form on the basis of a hypersonic thin shock-layer analysis and a local similarity type of approximation. One of the important results of the numerical calculations is that local heat-transfer rate at low Reynolds number can be greater than the free molecule value with a unit accommodation coefficient. Author

N65-15716# AVCO-Everett Research Lab., Everett, Mass. Bell Telephone Labs., Inc., Point Mugu, Calif.

THE NEAR WAKE OF A WEDGE

R. Weiss Dec. 1964 47 p refs Prepared for Bell Telephone Labs.,

(Contracts DA-30-069-ORD-1955; AF 04(694)-414)

(AVCO-Everett Res. Rept.-197; BSD-TDR-64-150; AD-609577)

An analytical model of the two-dimensional laminar near wake is described. All relevant physical features of the flow, including the boundary layer expansion at the shoulder, free shear layers, recirculation regions, and recompression region are included. A tractable problem is formulated by matching approximate solutions for each of these regions along mutual boundaries. A set of coupled algebraic equations was derived, and numerical results were obtained for the conditions of a wind-tunnel wedge experiment. Satisfactory agreement was obtained between the measured and theoretical variation of base pressure with Reynolds number. Additional computations are carried out for a series of wedges of different length, apex angle, and wall temperature. The variation of base pressure, wake angle, and neck enthalpy ratio with altitude is obtained for these bodies. It is shown that the near wake dimensions scale approximately with body size, and that the neck enthalpy ratio has a significant variation with body size, wall temperature, and altitude. Author

N65-15734*# Consultants and Designers, Inc., Arlington, Va.
TO THE THEORY OF HYPERSONIC FLOW OF VISCOUS GAS PAST BLUNT BODIES [K TEORII OBTEKANIYA TUPONOSNOGO TELA GIPERZVUKOVYM POTOKOM VYAZKOGO GAZA]
B. M. Bulakh 26 Jan. 1965 12 p refs Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 28, no. 6, 1964 p 1008–1014
(Contract NAS5-3760)
(NASA-TT-F-9632; ST-HF-GD-10282) OTS: HC $1.00/MF $0.50

Considered in this paper is a plane and axisymmetric problem of uniform hypersonic flow of viscous perfect gas past a blunt body where the standard boundary-layer theory is insufficient and requires higher approximations to the solutions of the Navier–Stokes equations. With the help of the well-known extrinsic and intrinsic expansions, conditions are obtained at the leading shock wave for a second approximation to the solution beyond the boundary layer (the first approximation being the nonviscous flow). Considered also are the boundary values, arising at determination of the second approximation. Author

N65-15754# Toronto U. (Canada). Inst. for Aerospace Studies
PRESSURE MEASUREMENTS IN LOW-ENERGY UNDERWATER EXPLOSIONS
R. B. Simpson Sep. 1963 50 p refs Sponsored by Defence Res. Board and ONR
(UTIAS-TN-72; AD-451644)

The experiments were performed in the UTIA steel shock sphere of 3 ft inner diameter, using 1 inch and 2 inch-diameter glass spheres pressurized up to 500 psi as safe explosive sources permitting close control of the initial conditions. The smaller spheres were used in measurements taken at 2, 5, 10 and 15 radii from the glass sphere for an initial pressure of 500 psi using air as the driver gas. The larger spheres were used in measurements in which the gage was placed initially in contact with the glass, so as to enter the bubble as it started to expand. For these runs, an initial pressure of 300 psi and driver gases helium, air, and sulfur hexafluoride were used. Simultaneously with the pressure-time measurements, space-time, drum-camera photographs were taken to measure the bubble expansion rate. The results were compared with the theoretical pressure field of a gas bubble expanding in an infinite incompressible medium allowing for the pressure wave propagation time. The agreement between the measurements and the theoretical predictions was generally satisfactory. Author

N65-15767# Aberdeen Proving Ground, Md. Terminal Ballistics Lab.
EXPERIMENTAL SURVEY OF AN EXPANSION OF A PLANE SHOCK ON A FLAT PLATE IN FREE AIR
Joseph F. Melichar Jul. 1964 35 p refs
(BRL-TN-1544; AD-453085)

The pressure-time history of a plane shock wave exiting from a shock tube onto a flat plate in free air was determined. The charge-distance relationship for spherical pentolite detonations to produce similar waves was calculated. For short durations, 0.5 to 2 milliseconds, the side-on pressures on the plate were found to be equivalent to the pentolite produced shock waves. Author

N65-15787# ARO, Inc., Arnold Air Force Station, Tenn.
LAMINAR BOUNDARY-LAYER SEPARATION ON FLARED BODIES AT SUPERSONIC AND HYPERSONIC SPEEDS
J. Don Gray Arnold Eng. Develop. Center, Jan. 1965 56 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-277)

Experiments at supersonic speeds and at Mach 8 were conducted to determine the conditions governing the extent of shock-induced laminar flow separations on axisymmetric configurations at zero yaw and without heat transfer. From an extensive correlation of surface pressure data and schlieren photographs, it was shown that the extent of reverse flow is essentially a function of the ratio of the wetted length to the flare divided by the laminar boundary thickness there. As a result, the relative extent of laminar flow separation decreases with a unit Reynolds number increase and grows through an increase in Mach number. Finally, increasing the flare angle increases the length of the reverse flow region. Author

N65-15789# Polytechnic Inst. of Brooklyn, N.Y.
FURTHER SIMILARITY SOLUTIONS OF WAKES AND JETS. PART I: TWO-DIMENSIONAL FLOWS. PART II: AXISYMMETRIC FLOWS
Martin H. Steiger, Karl Chen, and Martin H. Bloom Sep. 1964 22 p refs
(Grant AF-AFOSR-1-63)
(PIBAL-811; AFOSR-64-1944; AD-609576)

Solutions of the Falkner–Skan Equation

$$f''' + ff'' + \beta[1 - f'^2] = 0$$

subject to the boundary conditions

$$f(0) = f''(0) = 0, f'(\infty) = 1.0$$

describe the two-dimensional, isoenergetic, symmetric viscous free-mixing with streamwise pressure gradient under conditions of similarity. Solutions of the equations are derived in the ranges $-1.0 < \beta < -0.5$ and $1.0 < \beta$. Exact solutions obtained by a forward numerical integration and approximate integral method solutions are presented. The numerical integration uses a fourth order Runge–Kutta scheme. The second half of the report discusses solutions to the similarity equation

$$[\eta(\frac{F'}{\eta})']' + F(\frac{F'}{\eta})' + \beta\eta\,[1 - (\frac{F'}{\eta})^2] = 0$$

subject to the boundary conditions

$$\text{at } \eta = 0,\ F = (\frac{F'}{\eta})' = 0 \text{ and as } \eta \to \infty,\ \frac{F'}{\eta} = 1.0.$$

This equation describes incompressible axisymmetric free-mixing with streamwise pressure gradients. An extension to compressible flow is described which applies rigorously if the density ratio can be only a function of the similarity variable. Exact and integral method solutions are presented in the ranges $-0.1 < \beta < -0.5$ and $0.5 < \beta < 4.0$. D.S.G.

N65-15983# Massachusetts Inst. of Tech., Cambridge. Hydrodynamics Lab.
BREAKWATER CHARACTERISTICS OF OPEN-TUBE SYSTEMS Hydrodynamics Laboratory Report No. 73
Arthur T. Ippen and Efstathios L. Bourodimos Jul. 1964 122 p refs
(Contract Nonr-1841(59))
(R64-33; AD-609270)

This study reports on the energy dissipation, reflection, and transmission achieved with various combinations of wave characteristics and arrangements of open tubes, as well as on the forces exerted by wave action on the breakwater. The pertinent parameters considered for this study covered wave steepness in the upstream region H_I/L_I, the ratio of average

tube length over wavelength L_T/L_i, the relative water depth covered by the tube array in relation to the depth of the channel, and with various tube arrangements. Some of the important conclusions are: (1) The increase of wave steepness causes an increase in power loss for the same value of L_T/L_i. (2) A decrease of the parameter L_T/L_i, i.e., an increase in wave length L_i of the incoming wave, causes a decrease in power loss for the same range of the wave steepness. (3) The greater values of power loss for the same range of wave steepness appear generally for irregular tube arrangements. Uniform arrays of the short and long tubes and uniform tube arrangement were less effective. Author

N65-16088# Oceanics, Inc., Plainview, N.Y.
ON THE HYDRODYNAMIC STABILITY THEORY OF PLANE AND AXISYMMETRIC PARALLEL FLOWS [ZUR HYDRODYNAMISCHEN STABILITATSTHEORIE EBENER UND AXIALSYMMETRISCHER PARALLELSTROMUNGEN]
H. Schade Oct. 1964 185 p refs Transl. into ENGLISH of DVL Rept. 190, (Porz Wahn), Oct. 1962 Previously announced as N63-16145 13-11 *Its* Rept.-64-18
(Contract Nonr-4432(00))
(DVL-190; AD-608096)

A flow with parallel and straight streamlines is called parallel flow; its velocity field can be represented in Cartesian coordinates in the form $\tau = [0,0,w(x,y)]$. If, in particular, $w = w(x)$ or $w = w(x^2 + y^2)$ then it is called plane or axisymmetric parallel flow, respectively. This paper tells how the linearized stability theory for plane parallel flows can be applied to axisymmetric parallel flows. In the first part a compact presentation of the Tollmien–Schlichting–Linschen theory for plane parallel flows is given. The second part treats the stability of axisymmetric parallel flows, first for general three-dimensional disturbances, and then in detail for axisymmetric disturbances. Author

N65-16143# Illinois U., Urbana. Charged Particle Research Lab.
EFFECTS OF ELECTROSTATIC FORCES ON DROP COLLISION AND COALESCENCE IN AIR
Hubert Russel Plumlee (M.S. Thesis) 25 Sep. 1964 115 p refs
(Grants AMC-63-G2; NSF GP-2528)
(CPRL-8-64; AD-608382) OTS: $4.00

The coalescence of a pair of drops 2 millimeters in radius, immersed in air, is investigated by first considering a mathematical model which includes the hydrodynamic flow of the air from between the two approaching surfaces, the effect of the flattening of the adjacent surfaces, and the effect of an electric potential between the drops. With this model, the time required for the surfaces to move a given distance is determined as a function of the viscosity of the air and the potential difference. High-speed photographs of the profile view of two colliding drops are used in support of this model. The time interval between the initial deformation of the approaching drops and their coalescence, the rate of growth of the flatten deformation of the adjacent surfaces, and the collision velocity of the drops are measured. It was found that the time for coalescence is independent of moderate charges in the air pressure, varies inversely with the potential difference, and decreases for an increase in the collision velocity. Also, the time interval during which charge flows between the drops before they actually coalesce is investigated. Author

N65-16145# David Taylor Model Basin, Washington, D.C. Hydromechanics Lab.
WAKE SURVEYS BEHIND HYDROFOIL-STRUT-NACELLE CONFIGURATIONS—FOR APPLICATION TO THE AG(EH)
Wilburn L. Moore Jun. 1964 39 p refs
(DTMB-1864; AD-603062) OTS: $3.00

Wake surveys were conducted in the subsonic wind tunnel on a model of the AG(EH) main strut-pod-foil configuration with and without a pod fairing, and on three related strut-pod-foil configurations. The report presents the results of these wake surveys. One of the significant results is that each pod corner causes an additional stress reversal per cycle on the propeller blades, intensifying fatigue and vibration problems. Author

N65-16223# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
THE EFFECT OF WALL ELASTICITY AND SURFACE TENSION ON THE FORCED OSCILLATIONS OF A LIQUID IN A CYLINDRICAL CONTAINER. PART I: ANALYSIS
P. Tong and Y. C. Fung Oct. 1964 38 p refs Sponsored by AF
(SM-64-40; AFOSR-64-2019; AD-608548)

The stability of a fluid contained in a circular cylindrical tank with a flat, flexible bottom under a periodic axial excitation is studied. An analytical difficulty for the solution of the linearized equations in the form of infinite series is discussed. A variational approach is formulated. An approximate solution results in a pair of coupled ordinary differential equations with periodic coefficients. A method of handling the stability of the solutions of such a system of equation is presented. Author

N65-16245# California U., Los Angeles.
EXPERIMENTS CONCERNING THE HARTMANN WHISTLE
Timothy J. B. Smith and Alan Powell Sep. 1964 77 p refs
(Contract Nonr-233(62))
(Rept. 64-42; AD-608808)

The Hartmann whistle, in its most basic configuration, consists of a flat-bottomed, cylindrical cavity that is axially aligned with a supersonic air jet of the same diameter. Discrete-frequency oscillations of the enclosed air column are driven at large amplitudes when the cavity is located within certain regions of the cellular structure of the jet. An optical and acoustical study of the phenomenon is described, together with that of the Hartmann pulsator. In the latter form the whistle has the small cavity replaced by a large Helmholtz-type resonator with the same orifice diameter, resulting in a large-amplitude aeroacoustic oscillator with a periodic time of several orders of magnitude greater than for the regular whistle. The underlying cause of the newly discovered bistable condition of the normal shock disc located in the airstream between the nozzle and the cavity orifice is an important aspect which makes possible a (presently qualitative) theory of operation which accounts for the principal features of the Hartmann whistle and its direct derivatives. Some other aspects still requiring further elucidation are mentioned. The report includes a brief review of the currently available literature pertaining to the phenomenon. Author

N65-16269*# Pennsylvania State U., University Park. Ionosphere Research Lab.
THE HELICAL MOTION OF A SPHERE IN THE PRESENCE OF A MAGNETIC FIELD
David P. Hoult [1963] 10 p refs Submitted for Publication
(Grant NsG-134-61)
(NASA-CR-60518) OTS: HC $1.00/MF $0.50

When a sphere is released in a tank of mercury, in the presence of a uniform applied magnetic field aligned with the direction of gravity, the sphere is observed, for some values of the applied magnetic field, to rise in a steady helical motion. A

theory is presented that describes this effect. The main results are relationships between the drag on the sphere, the wave length of the helix, and the strength of the applied magnetic field; these relations must be satisfied if a steady motion occurs. It is believed that this calculation is a new application of the theory of hydrodynamic stability of parallel flow. Author

N65-16272# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
COMPARISON OF FINITE DIFFERENCE EXPRESSIONS USED IN LAGRANGIAN FLUID FLOW CALCULATIONS Technical Report No. 106-4, 30 Sep. 1962–24 Jun. 1964
W. Herrmann Kirtland AFB, N. Mex., AF Weapons Lab., Nov. 1964 60 p refs
(Contract AF 29(601)-4601)
(WL-TR-64-104; AD-608543)

A number of commonly used finite-difference analogs to partial derivatives in two space dimensions are investigated, and a few variations are proposed. The accuracy of these analogs is assessed by obtaining numerical results for deformations for which the analytical gradients can be evaluated. None of the analogs appeared superior for those deformations which were investigated, and it appears that a choice may be made on the basis of computational convenience. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-15437 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE FORMATION OF IONS IN THE IONOSPHERE
A. D. Danilov *In its* Cosmic Res. 13 Jan. 1965 p 75–101 refs (See N65-15432 06-30)

This article considers questions relating to the formation of primary ions in the ionosphere at altitudes of 100 to 200 km. A comparison of the effectiveness of the various processes provides the basis for the selection of the primary means of forming each ion. The calculation of the equilibrium concentrations of the ions O^+, NO^+, O_2^+, and N_2^+ is presented for the various zenith angles of the sun. It is demonstrated that the altitude curves of the concentrations of these ions and of the concentration ratios, these curves having been computed theoretically, are in good agreement with existing experimental data for various magnitudes of $z_\odot$. The adoption of the Hinteregger data on the low intensity of ultraviolet radiation from the sun, or of the Ivanov-Kholodnyy data on a heavy flux in the ultraviolet region of the spectrum, does not significantly change the derived conclusion regarding the coincidence of ion-concentration distribution, calculated theoretically and measured experimentally, but leads rather to a change in the magnitudes of the process constants. The derived data make it possible to evaluate the most probable values of the constants for the primary processes taking place in the ionosphere.
Author

N65-15438 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE THERMAL EMISSION OF A SPHERICAL ATMOSPHERE
L. I. Koprova and M. S. Malkevich *In its* Cosmic Res. 13 Jan. 1965 p 102–134a refs (See N65-15432 06-30)

The solution of the equation for the transfer of thermal radiation in a spherically symmetric atmosphere is expressed in terms of a transmission function averaged over individual spectral intervals. An approximation of the transmission function is proposed to provide for its reliable extrapolation to the region of great absorbent masses. Expressions for the determination of intensity were obtained, as well as for the flow and influx of radiation emanating from the upper boundary of the spherical atmosphere, and also for the averaged parameters of the atmosphere as well as their random variations. The angular variation in the intensity of the thermal radiation in various sections of the spectrum was calculated; this radiation emanated from the upper boundary of a spherically symmetric atmosphere. The changeability of the fields of emanating radiation is examined; this changeability is governed by variations in the temperature of the ground surface and the atmosphere, the cloud cover, and other factors determining the emanating radiation. Author

N65-15439 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CORRELATION BETWEEN THE RESULTS OF OBSERVATIONS OF THE EARTH'S THERMAL RADIATION AS A FUNCTION OF THE PROPERTIES OF THE INSTRUMENT USED
V. A. Baryshev *In its* Cosmic Res. 13 Jan. 1965 p 135–147 refs (See N65-15432 06-30)

The subject of discussion is the dependence of the autocorrelation function for the results of observations on the properties of the optical instrument employed in experiments related to measurement of the fluxes of thermal radiation emanating from the earth. Certain specific scanning laws are analyzed. The results are represented in the form of series expansions of the functions under consideration, with the series suitable for calculations on the assumption that the necessary information on the outgoing radiation is known. Author

N65-15440 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DENSITY OF THE UPPER ATMOSPHERE DURING THE YEARS OF MINIMUM SOLAR ACTIVITY
M. Ya. Marov *In its* Cosmic Res. 13 Jan. 1965 p 148–163 refs (See N65-15432 06-30)

Results from the determination of the density of the upper atmosphere at altitudes approximately between 200 and 300 km are reported, these results having been obtained from the deceleration of the Soviet Kosmos series of artificial satellites of the earth and the space capsule of the first Soviet space vehicle (1960, ϵ_3). It is shown that at an altitude of about 200 km the density diminished approximately by a factor of two, while in the vicinity of the 300 km level the reduction is at least by a factor of three, which corresponds approximately to the change in the decimeter radio emission of the sun during the period between the years of maximum and minimum levels of solar activity. Noticeable diurnal variations in density have been ascertained in the indicated range of altitudes. Author

N65-15441 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENT OF ATMOSPHERIC DENSITY IN THE ALTITUDE INTERVAL BETWEEN 50 AND 70 km
Yu. A. Bragin *In its* Cosmic Res. 13 Jan. 1965 p 164–169 refs (See N65-15432 06-30)

Results are presented for a rocket experiment on the measurement of mesospheric density with the use of an ion densimeter in which lithium ions probing the density of the medium are introduced into the slightly perturbed atmospheric space ahead of the rocket nose section. Author

N65-15447 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
N(h)-PROFILES OBTAINED WITH THE VHF DISPERSION INTERFEROMETER IN LAUNCHINGS OF ACADEMY OF SCIENCES USSR GEOPHYSICAL ROCKETS DURING 1962–1963
V. A. Rudakov *In its* Cosmic Res. 13 Jan. 1965 p 217–220 refs (See N65-15432 06-30)

A VHF dispersion radio-interferometer, operating at frequencies of 144 and 48 mc, was used to measure the concentration of free electrons in the ionosphere. Conclusions agreed with experimental data on ion concentration. It was indicated: (1) As solar activity diminished during the 11-year cycle, N_i concentration diminished substantially, and also decreased more rapidly with increasing altitude above the principal ionization maximum. (2) Helium ions were present in considerable quantities at altitudes above 500 km, with concentrations of helium and oxygen ions approximately the same at 580 km. M.G.J.

N65-15480*# Virginia Polytechnic Inst., Blacksburg.
CONFERENCE ON ARTIFICIAL SATELLITES, PART A
Aug. 1964 177 p refs Conf. held at Va. Polytech. Inst., Blacksburg, 12–16 Aug. 1963 *Its* Bull., Eng. Expt. Sta. Ser. No. 156, Vol. 57, No. 8
(Contract NASr-226)
(NASA-CR-60133) OTS: HC $5.00/MF $1.00

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THE EARTH AND ITS ATMOSPHERE
1. AFTER NOW, WHAT THEN IN SPACE H. E. Newell (NASA, Washington) 14 p (See N65-15481 06-30)
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3. GEODETIC INFORMATION AND IMPLICATIONS J. O'Keefe (NASA. Goddard Space Flight Center) 13 p refs (See N65-15483 06-13)
4. THE EARTH'S ATMOSPHERE–DENSITY D. G. King-Hele (Royal Aircraft Estab., Farnborough) 31 p refs (See N65-15484 06-13)

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6. IONOSPHERE R. E. Bourdeau (NASA. Washington) 21 p refs (See N65-15486 06-13)
7. GEOMAGNETISM AND THE IONOSPHERE E. H. Vestine and J. W. Kern (RAND Corp.) 38 p refs (See N65-15487 06-13)

N65-15483* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEODETIC INFORMATION AND IMPLICATIONS
John O'Keefe *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. A Aug. 1964 13 p refs (See N65-15480 06-13) OTS: HC $5.00/MF $1.00

Measurements made on the earth's gravitational field by the aid of artificial satellites have led to some theoretical implications. The first measurements discussed refer to the flattening of the poles of a rotating spheroid. It is now possible to combine the flattening of the earth with the measurement of the luni-solar precession and calculate the polar moment of inertia of the earth. Measurements of the flattening led to the conclusion that the earth is not in hydrostatic equilibrium and the hydrostatic value has to be determined directly from the polar moment of inertia. The new equilibrium value of the earth's flattening is found to be near 1/299.8. The second discussion involves the difference between the actual flattening and the hydrostatic flattening, and the implications of this for the inner constitution of the earth. It was concluded that this difference is due to the slowing down of the earth's rotation. The subject of polytropic index and the relationship of tides with motion of the moon are discussed, as well as the theory of the breaking up by equatorial ejection of matter from a rotating body. The hypothesis that tektites come from the moon could be substantiated by this latter theory. R.E.S.

N65-15484* Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE EARTH'S ATMOSPHERE—DENSITY
D. G. King-Hele *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. A Aug. 1964 31 p refs (See N65-15480 06-13) OTS: HC $5.00/MF $1.00

After an introductory review of the entire atmosphere, this report discusses air density and its variations at heights of 200 to 2000 km, as revealed by analysis of satellite orbits and by other methods. The atmospheric density at three heights varies greatly in response to solar activity: At 600-km height, the density decreased by a factor of 30 between 1958 (sunspot maximum) and 1962 (near minimum). Density also varies strongly between day and night, the maximum daytime value exceeding the minimum nighttime value by a factor of up to 10 at some heights. Author

N65-15486* National Aeronautics and Space Administration, Washington, D.C.
IONOSPHERE
Robert E. Bourdeau *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. A Aug. 1964 21 p refs (See N65-15480 06-13) OTS: HC $5.00/MF $1.00

A general discussion is given of the neutral atmosphere. The subject areas on the D region include electron densities under quiet solar conditions, ion densities, the disturbed D region, and electron collision frequencies. The discussion of the E and F regions includes solar radiation intensity in the E and lower F regions, ion production and abundance in the lower ionosphere, and the diurnal behavior of the E region. Rocket measurements of electron and ion densities above the F2 peak and of electron temperature are described. Ionospheric research results from satellite experiments are reported, including satellite measurements of electron temperature, of ion compositions, and of local charged-particle densities. D.E.W.

N65-15487* RAND Corp., Santa Monica, Calif.
GEOMAGNETISM AND THE IONOSPHERE
E. H. Vestine and J. W. Kern *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. A Aug. 1964 38 p refs (See N65-15480 06-13) OTS: HC $5.00/MF $1.00

The geometry of the magnetosphere and the dynamics of energetic particles and plasma trapped within it are discussed

in relation to some problems of geomagnetism. Local acceleration of trapped particles is discussed, and the possible origins of electric fields and their roles in this and other magnetospheric phenomena are noted. It is found that many phenomena of interest may be newly interpreted, in terms of the original Chapman–Ferraro theory of geomagnetic storms. Author

N65-15542# Defence Research Board, Ottawa (Canada). Directorate of Scientific Information Services

CONCERNING MAGNETIC FIELD VARIATIONS IN THE CARRYING OUT OF PRECISE REGIONAL AEROMAGNETIC SURVEYS

I. M. Pudovkin Jun. 1963 4 p ref Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geofiz. (Moscow), v. 8, 1956 p 997–998

(T-393-R; AD-607434)

The magnetic field variations in subpolar areas proceed differently at points that are separated by 200- to 300-km distance. The necessity of a network of frequent aeromagnetic observation stations to cover the survey area adequately is investigated. The magnetic variations of the horizontal and the vertical field components and of the total intensity vector of several stations were observed, and a formula for subpolar regions where the magnetic dip is near to $\pi/2$ was developed, and is presented. G.G.

N65-15587# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.

A PROPOSED SOLUTION TO SOME GEODESY AND TIMING PROBLEMS

K. A. Norton and M. C. Thompson, Jr. 30 Oct. 1964 50 p refs

A system is described which should make possible the accurate determination of the locations, in three dimensions relative to a right ascension-declination system with its axis coinciding with the rotation axis of the earth, of a worldwide network of points completely encompassing the earth. The system involves the measurement of the transit times of radio waves from these points on the ground to and from a sun-illuminated satellite in a near-circular polar orbit at a nominal altitude of 4100 km. It is shown that this system may also be used for the more accurate dissemination of time signals with uncertainties limited, for the foreseeable future, only by the electronic instrumentation instabilities available at each of the transmission points rather than, as with all other currently available systems, by instabilities in propagation. Author

N65-15620# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.

ANTARCTIC RESEARCH AND DATA ANALYSIS: AN ELECTRON BOMBARDMENT THEORY OF HIGH-LATITUDE SPORADIC-E Scientific Report No. 17

S. M. Bennett and T. M. Noel 25 Sep. 1964 47 p refs

(Contract NSF C-255)

(RAD-TR-64-29; AD-608126) OTS: $2.00

On the basis of a power spectrum analysis of the foEs time series at the Antarctic stations Wilkes and Byrd, periodic tendencies of the order of hours were uncovered. The principal (and secondary) periods in hours are: Wilkes 1.7(2.4); Byrd 2.2(1.1). It is possible to derive a model of quasi-periodic variations which is related to the loss of electrons from the Van Allen radiation belt. Thin-layer sporadic-E results from the magnetospheric time-of-flight spectrometer effect when the source is longitudinally small. The periodicity of the resultant variation in electron density at a point longitudinally removed from the disturbance source (but on the same L-shell) is dependent upon the particle source spectrum and the Coulomb-scattering loss coefficient, and these factors are, at present, poorly understood. The longitude effect in high-latitude sporadic-E occurrence is ascribed to the longitudinal dependence of the effective loss coefficient for a particle whose mirror point drifts on a surface of constant magnetic field strength. Author

N65-15683# Joint Publications Research Service, Washington, D.C.

STRUCTURE OF THE TEMPERATURE FIELD IN CUMULUS CLOUDS

N. I. Vul'fson and V. N. Ivanov 2 Feb. 1965 3 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 159, no. 4, 1 Dec. 1964 p 786–788

(JPRS-28597; TT-65-30262) OTS: $1.00

The basic source of energy for cumulus clouds is the heat of condensation, which leads to intensive convective motion within clouds. A certain lower limit of heterogeneities is introduced, along with the rate of dissipation of turbulent energy and the temperature field; and formulas are derived for calculating the structure functions of clouds. The order of magnitude of the turbulent exchange factor is estimated, and values of the rate of turbulent energy dissipation and the temperature field are calculated from measurements of temperature pulsations in thick cumulus clouds. It was found that these values correspond closely with those obtained by other methods. D.E.W.

N65-15684# Joint Publications Research Service, Washington, D.C.

GEOLOGICAL INVESTIGATIONS ON THE EXPEDITIONARY SHIP "POLYUS" IN 1963

I. P. Svirenko and A. V. Soldatov 3 Feb. 1965 9 p Transl. into ENGLISH from Okeanologiya (Moscow), v. 4, no. 6, 1964 p 1106–1110

(JPRS-28616; TT-65-30273) OTS: $1.00

Oceanographic investigations of the northwest sector of the Atlantic Ocean and of the Danish Straits during 1963 are reported. The studies were concentrated on the detailed bottom relief and on the distribution, nature, and properties of the bottom deposits. Over 19 000 miles were traversed on two cruises, during which 170 bottom photographs, 27 bottom samples and 26 rock samples were taken. On the first cruise, studies were made of the North American continental slope, the continental foot, the Hatteras abyssal plain, the northern part of the Bermuda rise, and the region of the Kelvin submarine mountains. On the second cruise detailed supplemental data were obtained on the relief of the Greenland-Iceland threshold and its southern and northern slopes. Some photographs of the bottom in various places are presented, showing limestone, lava fields, pebbles, gravel, and detrital material dropped by icebergs. A profile of the bottom from Greenland to Iceland is also shown. D.E.W.

N65-15685# Joint Publications Research Service, Washington, D.C.

GRAVITY SURVEYS AT SEA (1958–1960)

V. V. Fedynskiy 5 Feb. 1965 158 p refs Transl. into ENGLISH from Morskiye Gravimetricheskiye Issled., 1958–1960 (Moscow), no. 2, 1963 p 3–115

(JPRS-28648; TT-65-30284) OTS: $5.00

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2. GRAVIMETRIC WORK OF THE STATE ASTRONOMICAL INSTITUTE ON THE FIFTH SOVIET ANTARCTIC EXPEDITION OF 1959–1960 A. I. Frolov p 23–45 refs

3. GRAVITY FIELD OF THE ATLANTIC OCEAN AND ITS RELATIONSHIP TO THE DEEP STRUCTURE OF THE EARTH'S CRUST Ye. D. Koryakin p 46–65 refs

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9. THE ROLE OF OCEAN CURRENTS IN STUDY OF THE EARTH'S EXTERNAL GRAVITATIONAL FIELD N. P. Grushinskiy and M. U. Sagitov p 143–155 refs

N65-15730# Joint Publications Research Service, Washington, D.C.

TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 139

26 Jan. 1965 74 p refs Transl. into ENGLISH from Acta Met. Sinica (Peking), v. 34, no. 3, Aug. 1964 p 253–269, 271–298 (JPRS-28473; TT-65-30202) OTS: $3.00

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N65-15731 Joint Publications Research Service, Washington, D.C.

THE LONG RANGE VARIATION OF THE GENERAL CIRCULATION OF ATMOSPHERE UNDER THE INFLUENCES OF NON-ADIABATIC HEATINGS AND THE DYNAMIC EFFECT OF OROGRAPHY

Hsiung-Shan Ch'en *In its* Transl. on Communist China's Sci. and Technol., No. 139 26 Jan. 1965 p 1–21 refs (See N65-15730 06-13) OTS: $3.00

An ideal numerical experimental model of the general circulation of the atmosphere was constructed with simple considerations of the radiation, turbulence exchange, condensation heatings, and orographic effect. The effects of the ocean and the continent are presented by giving the earth surface temperature. The derived ordinary differential equations are numerically integrated on electronic computers by the Runge–Kutta method. Starting with an atmosphere in rest, the basic current is established by the effects of non-adiabatic heatings in 40 days. The basic current has the annual variation under the influences of solar radiation, the earth's surface temperature, and condensation heatings, all with an annual period. The amplitudes of disturbances decrease in summer, and increase in winter. The seasonal variation of the earth's surface temperature controls the movements of ultralong waves. The cold troughs are situated at the east of oceans in summer, and at the east of continents in winter. Author

N65-15732 Joint Publications Research Service, Washington, D.C.

A PRELIMINARY STUDY OF THE ACTIVITIES OF ULTRA-LONG WAVES IN RELATION TO THE DYNAMIC CONTROL OF LARGE-SCALE OROGRAPHY AND HEAT SOURCES

Pao-chen Chu *In its* Transl. on Communist China's Sci. and Technol., No. 139 26 Jan. 1965 p 22–42 refs (See N65-15730 06-13) OTS: $3.00

Through a simple theoretical model, some dynamic processes of ultralong waves in the troposphere as well as in the stratosphere were studied in relation to the heating and orographic influence. Orography and heat source can make ultra-long waves fluctuate and intensify about a certain geographic location. This explains the maintenance of quasi-stationary large troughs in the midtroposphere. The amplitude of ultra-long waves varies periodically with a period of 10 to 30 days, and its appearance depends upon the scale and the structure of the atmospheric movement, and on the earth's rotation. When the parameters of the atmosphere remain unchanged in an unlimited time, the field of motion tends to become steady. Author

N65-15733 Joint Publications Research Service, Washington, D.C.

ON THE FORMATION OF THE THERMAL WIND IN THE FOUR-LAYER BAROCLINIC ATMOSPHERIC MODEL

Ch'lu-shih Ch'en and Ming-te Li *In its* Transl. on Communist China's Sci. and Technol., No. 139 26 Jan. 1965 p 43–71 refs (See N65-15730 06-13) OTS: $3.00

A four-layer baroclinic atmospheric model was adopted to investigate how the nonthermal wind adjusts itself to the thermal wind state. The adjusting process was performed by four gravitational inertial waves whose wave front speeds are about 306 m/sec, 114 m/sec, 36.2 m/sec, and 19.2 m/sec respectively. It was found that the higher the level, the more important is the faster internal inertial wave in the process of adjustment, and that the external wave may be important only below the 750 mb level. The calculated results also indicated that the alternation of the divergence and convergence in the vertical, which is normally termed Dines' compensation, results from the formation of thermal wind under certain initial conditions. Calculations of the adjusting process with different initial nongeostrophic states were carried out to study the development of the large-scale weather system. Author

N65-15735*# Consultants and Designers, Inc., Arlington, Va.
OBSERVATIONS WITH THE HELP OF THE SATELLITE ELECTRON-2 OF THE RELATIONSHIP BETWEEN THE VARIATIONS OF THE MAGNETIC FIELD AND THE FLUXES OF POSITIVE IONS INSIDE THE EARTH'S MAGNETOSPHERE [NABLYUDENIYA PRI POMOSHCHI SPUTNIKA ELEKTRON-2 SVYAZI MEZHDU IZMENENIYAMI MAGNITNOGO POLYA I POTOKAMI POLOZHITEL'NYKH IONOV VNUTRI MAGNITOSFERY ZEMLI]
K. I. Gringauz, Sh. Sh. Dolginov, V. V. Bezrukikh, E. G. Yeroshenko, L. N. Zhuzgov et al 27 Jan. 1965 8 p refs Trans. into ENGLISH from Dokl. Akad. Nauk SSSR, Geofiz. (Moscow), v. 159, no. 6, 1964 p 1272–1275
(Contract NAS5-3760)
(NASA-TT-F-9633; ST-PF-GM-10283) OTS: HC $1.00/MF $0.50

Contrary to the indicated observations on the Explorer-12, the observations of positive ion fluxes refer to a region lying beyond the limits of the outer radiation belt, but within the magnetosphere, though the remoteness of the satellite from earth was about identical in both cases. This is connected with the various inclinations to the equator of both satellites' orbits. So far as is known such measurements were carried for the first time on Electron-2. One question remains obscure: Are the fluxes, observed with the aid of charged particle traps aboard Electron-2, due to solar wind having penetrated in the depth of the magnetosphere, or are they formed from particles of near-terrestrial plasma, accelerated with the aid of some still unknown mechanism? Apparently the phenomena are all related to essential details of the mechanism of geomagnetic disturbance onset. Author

N65-15755# Raven Industries, Inc., Sioux Falls, S. Dak.
[SUPPLIES, SERVICES, LAUNCHINGS, AND RESULTS OF A SERIES OF SKYHOOK BALLOON FLIGHTS] Final Report
J. E. Kittelson 31 Dec. 1963 14 p refs
(Contract Nonr-3390(05))
(Rept.-2263; AD-426487)

This undertaking included furnishing balloons, control instrumentation and telemetry, tracking and launch vehicles, materials and services for a series of Skyhook balloon flights. The launches were executed from Ft. Churchill, Manitoba, Canada; Flin Flon, Manitoba, Canada; Brownwood, Texas; Sioux Falls, South Dakota; and other specified locations where facilities were available and flight clearances could be obtained. Author

N65-15808# Texas Instruments, Inc., Dallas, Tex.
WORLDWIDE COLLECTION AND EVALUATION OF EARTHQUAKE DATA: EVALUATION OF 1963 SEISMICITY Final Report, 15 May 1961–15 Nov. 1964
Ray Fisher and Ralph Guidroz 18 Nov. 1964 187 p refs
(Contract AF 19(604)-8517; ARPA Order 292; Proj. Vela Uniform)
(AFCRL-64-964; AD-454572)

The worldwide level of seismicity in 1963 was shown to have been considerably lower than in 1960. Comparison with Gutenberg and Richter's (1954) data shows 1963 seismic activity about average with respect to total shocks $M_s \geq 6.0$. However, more shocks in the range $5.0 \leq M_s < 6.0$ were recorded in 1963 than predicted by Gutenberg and Richter. Epicenter maps, showing events for which $M_S \geq 4.0$ and $m_b \geq 4.0$ for shallow and normal focus and also for intermediate and deep focus events, are included. A seismicity map based on annual numbers of shocks ($5.0 \leq M_s < 6.0$) per unit area is also shown. Some 4800 events are listed, representing all known epicenter locations plus local earthquakes ($\Delta \geq 1000$ km) $^{*}M_S \geq 3.0$, which were recorded. Computed and published magnitude data are included in the lists. Author

N65-15815*# Pennsylvania State U., University Park. Ionosphere Research Lab.
SATELLITE STUDIES OF THE DISTRIBUTION OF IONIZATION ACROSS THE MAGNETIC EQUATOR Scientific Report No. 235
J. D. Kolesar 20 Feb. 1965 85 p refs
(Grant NsG-114-61)
(NASA-CR-60412) OTS: HC $3.00/MF $0.75

Several theories concerning the distribution of ionization about the magnetic equator under equilibrium conditions are discussed. The predictions were investigated experimentally, using topside sounder satellite data and also total electron content data obtained from satellite beacon experiments. It was found that the experimental data are in general agreement with an analytic model for the equatorial anomaly, although there are departures in detail. An equatorial trough in electron content is found to develop at about noon each day and to persist into late evening. Following local magnetic disturbances, the anomaly is less likely to be present. Author

N65-15840 Geotechnical Corp., Garland, Tex.
GRAVITY AND MAGNETIC SURVEY OF THE AREA WITHIN AND SURROUNDING THE WICHITA MOUNTAINS SEISMOLOGICAL OBSERVATORY SEISMOMETER ARRAY
11 Sep. 1964 50 p refs
(Contract AF 33(657)-12007)
(TR-64-103; AD-451283)

A two-phase gravity and magnetic survey was made of the Wichita Mountains area of southwestern Oklahoma. The Wichita Mountains area showed a positive Bouguer anomaly. The source of this gravity high is postulated to be a gabbroic body that underlies the entire Wichita Mountains horst. The local magnetic survey showed a group of positive and negative anomalies that are unrelated to changes in lithology or structure. These anomalies are apparently due to local changes in the intensity of remanent magnetization. At least part of these local changes are caused by the severe lightning discharges that occur frequently in the area. The WMSO area gravity survey showed several small negative anomalies. These are apparently caused by granite and rhyolite filling of the eroded gabbroic surface. Author

N65-15866# Joint Publications Research Service, Washington, D.C.
SOME NEW METHODS OF OCEANOGRAPHIC OBSERVATIONS
I. I. Stas' 3 Feb. 1965 Transl. into ENGLISH from Okeanologiya (Moscow), v. 4, no. 6, 1964 p 1096–1100
(JPRS-28615; TT-65-30272) OTS: $1.00

Descriptions and advantages of various types of stations for observations are presented. A pile station with an above sea level platform on four supports intended for acoustic observations in the sea is described. It also has hydrologic pickup devices. Stations on driven piles for determining only hydrometeorological parameters are described. One such station is placed below sea level and is made in two parts, which are separable, the tube and the instrument container. A third type of station is discussed which has a mobile pile foundation equipped with devices similar to pontoons. Several such floating, anchored or drifting, shore hydrometeorological stations have been designed. Applications for such stations have been discussed. Author

N65-15877# Stanford Research Inst., Menlo Park, Calif.
COSMIC NOISE AND IONOSPHERE STUDIES—PROJECT VELA, PART I Appendix to Final Report
J. C. Hodges, comp. Sep. 1964 58 p refs
(Contract AF 49(638)-989; ARPA Order 159-60)
(AD-451150)

Riometer record reproductions of 18-Mc and 30-Mc cosmic noise are presented for the period 11 June to 29 December 1963. The riometers were located near San Francisco, California. The riometer and the field site are described briefly, and the use of the data is explained. Author

N65-15914*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
PROJECT FOG DROPS: INVESTIGATION OF WARM FOG PROPERTIES AND FOG MODIFICATION CONCEPTS Quarterly Progress Report, 1 Oct. 1964–1 Jan. 1965
W. C. Kocmond and Robert L. Peace, Jr. [1965] 24 p ref
(Contract NASr-156)
(NASA-CR-60379; CAL-RM-1788-P-7) OTS: HC $1.00/MF $0.50

The program includes experimental models of the microscopic and macroscopic properties of warm fogs; the characteristics of aerosol droplets and the means of favorably altering them; the construction of apparatus for simulating certain fog conditions; experimental alteration of growth and evaporation rate of otherwise stable aerosol droplets; the formulation of fog modification concepts; and the assessment of supercooled-fog problems in the United States. Results provide significant insight into the nationwide climatology of fog, with differences in mean and modal frequency of heavy fog and differences in the degree of local influence from region to region. Area findings are that heavy fog poses no problem in the southwestern mountain region and only a moderate problem in the Great Plains. Fog is most frequent and quite local along the West Coast, in the Appalachian Mountains, and along the New England Coast. Along the Gulf and Atlantic Coasts and in the Great Lakes region, fog is quite frequent but local effects do not seem significant. R.E.S.

N65-15917# Israel Inst. of Technology, Haifa.
EMPIRICAL ASPECTS OF DIRAC'S GRAVITATIONAL HYPOTHESIS (CONTINUATION) Final Report I
Pascual Jordan 1964 93 p refs
(Contract AF 61(052)-567)
(ARL-65-22; AD-454988)

This paper is a continuation of a previously published discussion of empirical aspects of Dirac's hypothesis, entitled *Problems of Gravitation*. Discussions are devoted to Dirac's hypothesis, geophysics, and geology; the system of rifts and the formation of ocean basins; sources of quantitative information about the earth's expansion; the great glaciations; oceanographic progress; facts and theories about the earth's interior; the worldwide distribution of coal layers; and phase transitions and volcanic activity. It is concluded that a large number of empirical facts seem to confirm Dirac's hypothesis. D.E.W.

N65-15918*# Minnesota U., Minneapolis.
DIFFUSIVE SEPARATION IN THE UPPER ATMOSPHERE
A. E. Hedin and Alfred O. Nier [1964] 7 p refs Submitted for Publication
(Grant NsG-286)
(NASA-CR-60438) OTS: HC $1.00/MF $0.50

The magnetic mass spectrometer on an Aerobee flight measured the principal neutral constituents of the atmosphere in the altitude region 100 to 200 km. The data were fitted to a theoretical expression that took account of rocket trajectory, source orientation, and source geometry. The analysis showed that the heavier the particle, the more rapid was the decrease of density with altitude. This is in qualitative agreement with expectations, if the particles are in diffusive equilibrium. Another conclusion reached was that the oxygen in the upper atmosphere should be in diffusive rather than photochemical equilibrium. The mathematical problem relating pressure, number density, and mass of particle to altitude in an atmosphere of hydrostatic equilibrium is discussed. Agreement between calculation and experiment was very close. R.E.S.

N65-15973# Air Force Cambridge Research Labs., Bedford, Mass. Meteorology and Aerospace Instrumentation Labs.
HOURLY RAWINSONDES FOR A WEEK, PART II
Arnold A. Barnes, Jr. and Henry A. Salmela Nov. 1964 19 p refs *Its* Spec. Repts. No. 10
(AFCRL-64-886, Pt. 2; AD-608779)

During the first seven days of April 1960, hourly rawinsonde runs were made at Bedford, Mass. This report describes in detail the data-heights, temperatures, relative humidities, and the components of the wind as given on IBM punch cards. The data are tabulated in two forms. In the first form, 30 pressure levels from 1000 mb to 10 mb are used. In the second form, the position of the balloon is given for each minute of flight. Information on obtaining the IBM punch cards is included. Author

N65-15982# Measurement Analysis Corp., Los Angeles, Calif.
SPECTRA AND AUTOCORRELATION FUNCTIONS FOR FULLY DEVELOPED SEAS AND PREDICTION OF STRUCTURAL FATIGUE DAMAGE
Julius S. Bendat Sep. 1964 31 p refs
(Contract Nonr-4305(00))
(MAC-307-04; AD-608464)

This report analyzes the Pierson–Moskowitz spectrum for fully developed seas and obtains further properties about its structure. Results are obtained for two distinct applications: determination of the corresponding autocorrelation function, and prediction of possible associated structural fatigue damage for single degree-of-freedom systems. Author

N65-16068# National Oceanographic Data Center, Washington, D.C.
A SUMMARY OF TEMPERATURE-SALINITY CHARACTERISTICS OF THE PERSIAN GULF
Harold W. Dubach, comp. 1964 225 p refs
(G-4) Available from Naval Oceanog. Office, Washington, D.C.: $2.50

An analysis of recent temperature-salinity observations (taken since 1950) was prepared and is included; charts for each observation series are presented for the surface, 10-, 20-, and 30-m levels. The position or location of observations is shown in section I; the appendixes contain the observational data upon which the analyses are based. The distribution of bathythermograph data by 1° squares was charted and included. Results of a 1961 survey (NODC Cruise 31865) are included; analyses for these data are not presented. Author

N65-16069# National Oceanographic Data Center, Washington, D.C.
INTERNATIONAL COOPERATIVE INVESTIGATIONS OF THE TROPICAL ATLANTIC: EQUALANT II Data Report, 1964

Albert M. Bargeski and John R. Frank comp. [1964] 757 p refs (G-5) Available from Naval Oceanographic Office, Washington, D.C.: $5.00

Eight countries committed 11 vessels to Equalant II, which was planned as a 15-day comprehensive multiship synoptic observational program to measure selected physical, chemical, biological, and meteorological properties in the tropical Atlantic Ocean. Most of the planned objectives were achieved; however, because some vessels arrived later than scheduled, the program was not entirely synoptic. The observations and samples common to most of the vessels at designated intervals were: hydrographic casts, bathythermograms (BT), meteorological data, C-14, microbiomass, zooplankton, and night light collections. Special detailed studies of currents were undertaken by two of the vessels, and one vessel did considerable bottom trawling. D.S.G.

N65-16073# Naval Air Development Center, Johnsville, Pa. Anti-Submarine Warfare Lab.

TRANSIENT MICROPULSATIONS ASSOCIATED WITH GEOMAGNETIC BAYS AND EVIDENCES OF HYDROMAGNETIC ORIGIN IN THE EARTH'S OUTER ATMOSPHERE

Ronald P. Lepping (M.S. Thesis–Drexel Inst. of Tech.) 12 Oct. 1964 78 p refs

(NADC-AW-6419; AD-608138)

This analysis comprised theory and experiment. A partial data analysis and correlation was performed on the pertinent characteristics of 374 pt-bays observed over a 2-year period. For first-choice examples, the greatest density of occurrences took place around local midnight, and an unexpectedly high percentage of negative-polarity bays was particularly evident. Observations indicate that the bay-associated transient micropulsations are of hydromagnetic wave origin, with the most frequently occurring period of oscillation being 60 seconds. Author

N65-16076*# RAND Corp., Santa Monica, Calif.

METEOROLOGICAL SATELLITE OBSERVATION OF THERMAL EMISSION (PART 2 OF AN EXAMINATION OF THE APPLICATION TO SATELLITE METEOROLOGY OF VARIOUS SEGMENTS OF THE ELECTROMAGNETIC SPECTRUM)

W. W. Kellogg, K. J. K. Buettner, and E. C. May Dec. 1964 110 p refs

(Contract NASr-21(07))

(NASA-CR-60483; RM-4392-NASA) OTS: HC $4.00/MF $0.75

The physical principles involved in thermal emission in both the infrared and microwave parts of the spectrum, and the laws governing the absorption of such emission by the atmospheric constituents, water vapor, carbon dioxide, and ozone, are discussed. A discussion of the emissivities of both land surfaces and the surface of the sea is included. The observational capabilities of meteorological satellites are described which include measurements of somewhat different atmospheric parameters, such as cloud heights, surface temperatures, the vertical temperature distribution, flux and heat through the oceanic surfaces, the heat budgets of various earth regions, and the distribution of rainfall. New passive microwave (0.5 to 10 cm) systems were developed that permit the detection of thermal flux in a part of the spectrum with wavelengths longer than 3 cm. G.G.

N65-16089# Naval Research Lab., Washington, D.C. Sound Div.

COMPUTATION OF ACOUSTIC RAYS FROM TEMPERATURES MEASURED IN THE DEEP OCEAN AND PREDICTION OF THE RANGE TO THE CONVERGENCE ZONE Interim Report

R. L. Steinberger 28 Aug. 1964 29 p refs

(NRL-6123; AD-606391) OTS: $0.75

When sound waves from a simple source are ejected into the ocean, the outward motion of the wave fronts is controlled by the speed of sound, which is a function of the depth. Temperature soundings by means of a 900-ft bathythermograph and Nansen bottle casts were made to determine the sound speed c as a function of the depth z. Coordinate acoustic soundings to 1000-ft depths were made. Geometric ideas are developed for use in arithmetically calculating the predicted sound pressure. The basis of the calculations is the sound speed function c(z) determined at the place and time of the acoustic soundings. Computational methods are developed and used to obtain numerical values for horizontal ranges to the convergence zone. These values agree quite well with experimentally determined values. Author

N65-16119# Maryland U., College Park. Center for Atmospheric and Space Physics

THE DEVELOPMENT OF AN *IN SITU* PROBE SYSTEM FOR THE MEASUREMENT OF IONOSPHERIC PARAMETERS, VOLUME I

Richard T. Bettinger (Ph.D. Thesis) Jan. 1965 254 p refs

(Contract AF 19(604)-3861; AF 19(604)-5575; AF 19(628)-2792)

(AFCRL-64-676, Vol. I; AD-609360)

Designed and tested was a complete in situ probe system consisting of (1) thermal equalization probes capable of independently measuring vehicle potential, (2) a pulse probe to measure electron concentration and energy distribution and (3) a Langmuir probe which will supply information on positive ion and electron temperatures. This system, along with the requisite telemetry elements, was then packaged into an ejectable rocket payload. Preliminary flight test results are presented, indicating generally satisfactory operation of the various probes and pointing to a number of design modifications. Vehicle potentials were measured on several flights. Its reaction to dc sweeps, vehicle velocity and solar radiation is demonstrated and discussed. It is concluded that a high energy tail in the normal daytime electron energy distribution exists. Author

N65-16137# Joint Publications Research Service, Washington, D.C.

EVALUATING THE CHARACTERISTICS OF TURBULENT MIXING IN THE LOWER LAYER OF THE ATMOSPHERE

V. N. Ivanov 9 Feb. 1965 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geofiz. (Moscow), no. 12 Dec. 1964 p 1869–1877

(JPRS-28673; TT-65-30294) OTS: $1.00

The mixing processes are determined by the field of velocities of the wind which has a turbulent nature. To determine the local properties of the boundary layers, the rate of dissipation of turbulent energy, ϵ, must be determined. The "2/3 law" of Kolmogorov and Obukhov was used. Estimates of the characteristics of turbulent diffusion for the lower layer of the atmosphere were made for the spreading of a cloud of particles in a homogeneous isotropic turbulent flow. The order of magnitude of the parameters of turbulent diffusion for the lower layer of the atmosphere was estimated. The results indicated that, on the average, the ratio of concentration ceases to vary in time beginning at a distance of 3 to 4 km, which in turn agrees with the estimate that for the lower 100-meter layer the values of t (the magnitude of time) are reduced. R.E.S.

N65-16151# Joint Publications Research Service, Washington, D.C.
TRAJECTORIES OF TURBULENT HEATED STREAMS IN THE ATMOSPHERE
L. G. Kachurin, V. I. Bekryayev, and G. P. Dydina 9 Feb. 1965 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geofiz. (Moscow), no. 12, Dec. 1964 p 1859–1868
(JPRS-28672; TT-65-30293)

An upward heated jet, crossing an atmosphere with wind, is considered. Three sections of the jet are discussed: In the active section, the jet velocity is considerably greater than the wind velocity. The passive section is that in which the velocity of the jet, along its axis relative to the air, is negligible. The intermediate section lies between the other two sections. Equations were developed for the active section, and it was investigated experimentally. The passive section of a jet is discussed at length, and smoke plumes rising from factory chimneys were observed while meteorological measurements were being made. The theoretical treatment developed agrees accurately with observational results over a broad range of parameters of the jets and of the atmosphere. D.E.W.

N65-16188# Stanford Research Inst., Menlo Park, Calif.
HF COMMUNICATION EFFECTS SIMULATION: THE IONOSPHERE ABOVE 100 km, A SIMPLE MODEL Interim Technical Report No. 6
R. C. Whitten, G. Black, R. S. Edmonds, D. C. Lorents, I. G. Poppoff et al Aug. 1964 111 p refs
(Contract DA-36-039-SC-87197)
(DASA-1539; AD-451530)

A model of the quiet ionosphere in the altitude range 100 to 500 km for various conditions of solar activity is constructed. A model atmosphere, i.e., profiles of temperature density, pressure, number density of the various constituents, and scale height, based on rocket and satellite measurements and on models developed by other investigators, is also developed. From the model atmosphere and from measurements of the intensities of solar ionizing (extreme ultraviolet) radiations, ionization rate profiles are computed. Electron loss and diffusion processes and their associated rate constants are also treated, and the results (ionization, diffusion, and loss rates) are substituted into appropriately simplified forms of the continuity equation; the solutions yield the ionospheric model. The E- and F-region irregularities are also discussed, and a model of electron collision frequencies in the altitude range 100 to 500 km is presented. Author

N65-16189# United Electrodynamics, Inc., Alexandria, Va. Seismic Data Lab.
GENERAL SOLUTIONS OF THE WAVE EQUATION IN SPHERICAL COORDINATES FOR A SPECIAL CLASS OF ELASTIC ISOTROPIC INHOMOGENEOUS MEDIUM
Robert L. Sax 14 Nov. 1964 21 p refs
(Contract AF 33(657)-12447; Proj. Vela-Uniform)
(Rept.-111; AD-451024)

The elastic parameters in each shell of a layered elastic sphere are represented as continuously variable quantities. An approximate equation is derived for each isotropic inhomogeneous layer for which each elastic parameter varies with radial distance from the center of the sphere raised to any arbitrary power. General eigenfunction solutions are obtained that are only slightly more complicated than the solutions for the homogeneous shell. The order of magnitude of the maximum error in the equation can be evaluated for each inhomogeneous shell. A special kind of inhomogeneous medium is analyzed that results in an exponential eigenfunction solution for the radial part of the wave potential. It is shown that the wave equation for this medium is invariant under transformation by the reciprocal radii transformation. By applying spherical inversion to the eigenfunction solutions inside the sphere $r = a$, a rigorous sphere flattening approximation is carried out which could result in rapid accurate solutions for both Love waves and Rayleigh waves inside the sphere. Author

N65-16219# Weapons Research Establishment (Australia).
IONOSPHERIC DATA FOR DECEMBER, 1963 FROM WOOMERA, SOUTH AUSTRALIA
K. Page (Min. of Aviation, London) May 1964 24 p *Its* Ionospheric Data Bull.
(CPD-1963/12(w))

Tables of the hourly values of the customary ionospheric parameters are given for the station at Woomera for December 1963. Author

N65-16232*# Joint Publications Research Service, Washington, D.C.
RELATION BETWEEN VARIATIONS IN THE MAGNETIC FIELD AND POSITIVE ION FLUXES WITHIN THE EARTH'S MAGNETOSPHERE OBSERVED WITH SATELLITE ELEKTRON-2
K. I. Gringauz, Sh. Sh. Dolginov, V. V. Bezrukikh, Ye. G. Yeroshenko, L. N. Zhuzgov et al 9 Feb. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 159, no. 6, 21 Dec. 1964 p 1272–1275
(JPRS-28689; TT-65-30304) OTS: $1.00

The launching and orbit of the satellite Elektron 2 is briefly described, and instrumentation and other apparatus aboard the satellite is discussed. Some preliminary results are given of a comparison of data from satellite instruments with K_p indices of geomagnetic field disturbances, that were measured simultaneously on the ground. The comparison showed the existence of a correlation between changes of magnetic activity at the earth's surface, and changes of geomagnetic field intensity and ion fluxes at great distances from the earth. D.E.W.

N65-16266*# Geological Survey, Washington, D.C.
ASTROGEOLOGIC STUDIES. PART B: CRATER INVESTIGATIONS Annual Progress Report, Jul. 1, 1963–Jul. 1, 1964
Nov. 1964 194 p refs
(NASA-CR-60515) OTS: HC $5.00/MF $1.25

Crater investigations contain the results of field and laboratory studies of shock and crater phenomenology. The effect of shock on rock materials forms the subject of four reports: (1) the shock wave synthesis of stishovite, (2) the physical properties of shock-formed plagioclase from a meteorite, (3) some characteristics of natural glasses and high pressure phases that serve as evidence for their origin by meteorite impact, and (4) the effect of shock on the radiogenic argon content of granite. One report concerns the shock equation of state on two rocks from Meteor Crater, Arizona. Two reports deal with experimental craters: one is concerned with a field study of craters formed by missile impact, and the other, with a study of craters formed in porous-cohesive targets by hypervelocity projectiles. Work on three naturally formed craters is reported. This includes a new topographic map of Meteor Crater, Arizona, made to serve as a base for the geologic work; a geologic study of a meteorite crater and associated rays of ejecta at Henbury, Australia; and field and laboratory studies of the Flynn Creek structure, Tennessee. Author

N65-16267*# Geological Survey, Washington, D.C.
ASTROGEOLOGIC STUDIES. PART C: COSMIC CHEMISTRY AND PETROLOGY Fifth Annual Progress Report, Jul. 1, 1963 to Jul. 1, 1964
Nov. 1964 123 p refs
(NASA Order R-66)
(NASA-CR-60516) OTS: HC $4.00/MF $1.00

Cosmic chemistry and petrology include reports on aerodynamic features, geologic occurrences, chemical composition and metallic spherules of tektites, methods of chemical analysis of tektites and other extraterrestrial material, and the luminescence of achondritic meteorites. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-15427# Princeton U., N.J. Plasma Physics Lab.
IMAGE CONVERTER CAMERA FOR 0.5 to 10,000 MICROSECOND PHOTOGRAPHS
H. L. Miller Oct. 1964 24 p refs
(Contract AT(30-1)-1238)
(MATT-292)

Equipment is described for making photographs using an image converter tube as an electronic shutter. When operating in the framing mode, the camera will take three frames 10 μsec to 10000 μsec apart with exposure times from 0.5 μsec to 2000 μsec. Each frame has a maximum diameter of 25 mm. When operating in the streak mode, the camera has streak times from 10 μsec to 10000 μsec. The streak picture is about 60 mm long and 25 mm wide. The equipment uses the RCA 73435D image converter tube. A standard oscilloscope camera is used to record the images. Design of the equipment is discussed and circuits for controlling and timing the photographs described. Author

N65-15449# Tokyo U., (Japan).
MANUFACTURE OF A ZEHNDER-MACH INTERFEROMETER AND ITS APPLICATION TO FREE CONVECTION HEAT TRANSFER
Taik Sik Lee and Seung Duk Park [1964] 8 p refs *In* JAPANESE; ENGLISH summary

A Zehnder–Mach interferometer was designed and manufactured, and its performance was satisfactory. Some of the interferograms taken by the interferometer were shown. Principles of the interference method and interferogram analysis in the case of free convection were described. Also, design data of the interferometer were contained in this paper. Author

N65-15470 National Bureau of Standards, Washington, D.C.
REALISTIC EVALUATION OF THE PRECISION AND ACCURACY OF INSTRUMENT CALIBRATION SYSTEMS
Churchill Eisenhart *In* Army Res. Office Proc. of the 9th Conf on the Design of Expt. in Army Res., Develop. and Testing Dec 1964 p 469–536 refs Presented at 1962 Standards Lab Conf., NBS, Boulder, Colo., 8–10 Aug. 1962 Also published in J. Res. Natl. Bur. Stds., C: Eng. and Instrumentation, v. 67C no. 2, Apr.–Jun. 1963 (See N65-15451 06-19)

The measurement process is likened to production processes, with the product, in this case, being numbers. The concept of quality control is applied to measurement operations, and the necessity of determining the range of allowable variations in the measurement operation is stated. Conclusions are drawn about the relationship of inaccuracy in end results of measurements and a numerical confidence level. D.E.W.

N65-15512 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF A DC CIRCUIT CONTAINING A SEMICONDUCTOR THERMISTOR
A. G. Shashkov *In its* Trans. of Power Eng. 10 Sep. 1964 p 208–223b refs (See N65-15509 06-33)

Reported is a study of the transient processes in a dc circuit consisting of a linear resistor and a semiconductor thermistor. The basis of the investigation is the idealization of averaging the thermistor's temperature. Conclusions are developed that consider the static characteristics of the circuit and circuit equation transients that arise as a result of changes in the conditions of heat exchange between the thermistors and the environment. The conclusions reached are expressed by the following equations: (1) The conditions for the stability of the circuit are determined by the inequality

$$\frac{1}{aF}\beta_\theta \frac{U_{to}}{Uu}(U_{to} - U_R) I_o L1.$$

(2) The processes arising as a result of the relay effect can be considered in terms of the static voltampere characteristic and a ratio between the differential of temperature and time

$$\frac{d\bar{T}}{dt} = \frac{\Delta P_1}{cV}.$$

R.E.S.

N65-15513 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USE OF THERMISTORS FOR MEASUREMENT OF TEMPERATURE
V. N. Stanishevskiy *In its* Trans. of Power Eng. 10 Sep. 1964 p 224–229a refs (See N65-15509 06-33)

Calculations are presented to measure temperatures in the range from 60° to 180° C with an error of ±2° C together with the results of experimental tests, for which the range and error of measurements are defined by the technical specifications for an instrument intended for mold temperature measurement. The measuring circuit used was the bridge circuit, and two of these are described. Relations between resistances of the bridge circuit, with respect to ends of the measuring diagonal for a small resistance of the voltage current, are developed. The parameters are: (1) the thermistor parameters R_{20} and B; (2) the limits of measurement (T_1 and T_2); and (3) the millivoltmeter used as the indicating instrument. It was concluded that the instrument functioned well in the assigned range of temperatures and had a time lag shorter than that of a technical mercury thermometer, and the results of the calculations were in good agreement with the experimental data. R.E.S.

N65-15599# General Electric Co., Utica, N.Y. Light Military Electronics Dept.
QRC-139A AGE Final Engineering Report
15 Sep. 1964 55 p
(Contract 33(604)-39443)
(AD-451395)

A broadband spectrum analyzer with frequency converters was designed and developed for the QRC-139A countermeasures system. This broadband equipment displays the entire signal output, views the spectrum for holes or modulation difficulties, measures the absolute power density in direct readings at any point on the single-line trace, and measures the total power of the entire spectrum within a few minutes. Modification kits for the servo noise amplifier test set and the noise response test set were also developed. Performance test results of the broadband equipment were satisfactory, and are presented. It was recommended that the unit be redesigned for a smaller package size. G.G.

N65-15624# Texas U., Austin. Defense Research Lab.
[SOLION SEISMOMETERS] Quarterly Status Report (Annual Summary Rept.), 1 Aug.–31 Oct. 1964
C. M. Mc Kinney and D. W. Evertson 26 Jan. 1965 21 p
(Contract CGS-1198)
(QSR-4)

Solions, which make use of SOLution IONS for electrical charge transport, were used in the construction of one vertical and two horizontal seismometers. The vertical unit compared favorably with World Wide Standard Seismograph long- and short-period instruments, but the horizontal configuration records were noisy. The development of solion transducers for use in seismometers is discussed. The type of solion thus far used in seismometers is known as a solion polarized cathode acoustic linear (SPOCAL) transducer, and contains two individual sensors which basically respond to fluid volumetric displacement rate. R.L.K.

N65-15636# Atomic Energy of Canada Ltd., Chalk River, Ontario.
A THERMISTOR-TYPE LIQUID N_2 LEVEL CONTROL SYSTEM
D. A. S. Walker Dec. 1964 9 p refs
(AECL-2146; CRC-1211) Available from Atomic Energy of Canada, Chalk River: $0.20

A simple method of controlling the liquid nitrogen level in an enclosed Styrofoam housing is described. By placing the sensor above the upper liquid N_2 limit, it is not subjected to the large thermal variations experienced in other thermistor-type systems. The thermistor used as the sensing element possesses a resistance of 10Ω at 25°C. It is placed inside a small test tube which serves as a baffle between the thermistor and the liquid nitrogen. The thermistor-relay system is extremely sensitive to the applied dc voltage, and by carefully selecting the voltage and air pressure, it is possible to control the level of liquid nitrogen in a 1-liter dewar to within 1/2 in., with the thermistor about 4 in. above the liquid. R.L.K.

N65-15762 Army Missile Command, Huntsville, Ala. Army Inertial Guidance and Control Lab.
DEVELOPMENT OF A LOW COST GYRO USING PIEZOELECTRIC DITHERING
Aubrey Rodgers 15 Jul. 1964 13 p
(RG-TR-64-7; AD-454479)

Discussed is a method of improving the performance of a gyro without adding appreciably to its cost. This was accomplished by developing a low-friction suspension for the gyro output axis. The suspension design utilized a piezoelectric ceramic technique to reduce the gyro coefficient of friction. Experimental suspension models, incorporated into modified Norden RG-20 gyros, demonstrated that such a technique can improve the performance of a gyro. Author

N65-15822*# Electro-Optical Systems, Inc., Pasadena, Calif.
EVALUATION OF CRITICAL FACTORS RELATED TO A FLIGHT EXPERIMENT FOR REFLECTIVE SURFACE SAMPLES Final Report, 23 Mar.–20 Jul. 1964
P. A. Button 31 Jul. 1964 122 p refs
(Contract NAS1-3850)
(NASA-CR-60400; EOS-5101-Final) OTS: HC $4.00/MF $1.00

This report covers the evaluation of critical factors related to a flight experiment involving reflective surface samples. The program included the design, fabrication, and test of a prototype rotating arm reflectometer, and the evaluation of this approach for application to the flight experiment. Also reported are the results of studies for operating bearings and seals in space, valving for satellite control, and a general reliability analysis for the satellite. Further studies regarding methods of separating causes of sample degradation also are included. Author

N65-15852# Navy Underwater Sound Lab., New London, Conn.
DYNAMIC COUPLING COEFFICIENTS FOR DISTRIBUTED PARAMETER PIEZOELECTRIC TRANSDUCERS
William J. Marshall 16 Oct. 1964 32 p refs
(USL-622; AD-451430)

This report discusses a definition of the effective coupling coefficient for the body-force class of electromechanical transducers. This definition is based on the distribution of energy in the transducer and is therefore particularly applicable to the distributed parameter-type of transducer. Furthermore, the definition results in a frequency dependent coupling coefficient valid for all modes of vibration. The definition is applied to some common types of longitudinal vibrator, and the results are compared with experiments for one particular device (a partially excited stack of ceramic discs). The influence of parasitic elements on the system coupling is also examined. Author

N65-15895# Army Missile Command, Huntsville, Ala. Army Inertial Guidance and Control Lab.
SUPPLEMENTARY ANALYSIS AND EVALUATION OF ANALYTIC PLATFORM SYSTEMS—FY 64 (LESS APPENDIX C)
Robert E. Alongi 10 Jul. 1964 73 p refs
(RG-TR-64-10; AD-450416)

Reported is a compilation of the efforts in the analytic platforms field. Three instrumentations (three pulse rebalanced rate gyros and three pulse rebalanced accelerometers; three single-axis platform and three pendulous integrating gyro accelerometers; and six pendulous integrating gyro accelerometers operating in pairs) are described and analyzed with the assistance of computer and/or hand analysis for trajectories ranging from 40 to 300 NMI. The instrument error sources, error coefficients, and the results of the instrument error study are described. Developed are the range error associated with the size of the incremental readout at cutoff and the computation rates required of the gyro and accelerometer measurements to update the orientation and velocity matrix in the computer. Author

N65-15901# Hanford Atomic Products Operation, Richland, Wash. Physics and Instruments Lab.
MINIATURE SIGNALING RADIATION DOSEMETER
D. P. Brown Nov. 1964 17 p ref
(Contract AT(45-1)-1350)
(HW-83868)

A miniature, pocket-size dosemeter was developed to provide an audible signal at the accumulation of a preselected dose by the incorporated sensor (a standard pencil-type ionization chamber). The chamber was modified for automatic recharging. The dosemeter audible alarm is energized within ±10% of the preselected signaling set point, typically 100 mR, under dose rate conditions up to 3.6 R/hr. For dose rates of 6 R/hr and greater, the deviation limits are ±25%. The solid-state circuitry is powered by a single 1.35 V mercury battery that provides operation for about 1000 hr. A precharged capacitor provides voltage for the ion chamber. Author

N65-15935# National Oceanographic Data Center, Washington, D.C.
MANUAL FOR PROCESSING BATHYTHERMOGRAPH DATA. PART II: PROCEDURES FOR PROCESSING BATHYTHERMOGRAPH DATA IN ANALOG FORM Manual Series
1964 33 p
(M-3, Pt. II) Available from Naval Oceanog. Office: $0.50

The initial input to the processing sequence consists of: a glass slide bearing the analog record obtained during a lowering of the BT instrument, a log sheet or data form, and a specific temperature depth grid applicable to the instrument. The processing steps and quality control required to obtain an analog record of temperature against depth, correctly located in time and space, are described. The resulting reproducible photographic enlargement of the analog BT, trace positioned in temperature-depth coordinates, is released on a 3 in. × 5 in. ozalid print containing the photo image on one side and the identifying and environmental data on the other side. R.L.K.

N65-16040# Harry Diamond Labs., Washington, D.C.
A PROPOSED IR SCANNER OPTICAL SYSTEM
Donald Mary 5 Nov. 1964 17 p refs
(HDL-TR-1263; AD-454591)

A long-wavelength infrared optical system having a 30-cm aperture and a focal ratio of 1 is described. Scanning of the field of view is accomplished by an oscillating plane mirror in front of the detector. An optical layout is used, in which all optical surfaces are spherical and have common centers of curvature. Author

N65-16059# Data Corp., Dayton, Ohio.
IMAGE AMPLIFIER LABORATORY EVALUATION PROGRAM
Maurice B. Aufderheide and Neal Dougherty Wright-Patterson AFB, Ohio, AF Avionics Lab., 19 Oct. 1964 154 p refs
(Contract AF 33(657)-8611)
(FR-64-2; AL-TDR-64-211; AD-609945)

This report incorporates the results of the theoretical and laboratory evaluation of three nonscanning image amplifier camera systems. Initially, the test criteria for evaluating a nonscanning amplifier camera are discussed. The test techniques employed to determine the defining parameter also are presented. The employment of these techniques in the evaluation of the three image amplifier camera systems is illustrated. Author

N65-16100# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
SOLID STATE VIBRATING GYROSCOPE TECHNIQUE STUDY Final Report, Jun. 1963–Jul. 1964
J. J. Buckley, D. W. Roese, and J. W. Shearer Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1964 75 p refs *Its* Rept.-1712A
(Contract AF 33(657)-11629)
(FDL-TDR-64-101; AD-608428)

Described is an applied research effort with the specific objective of determining and demonstrating the practical feasibility of using the solid-state gyroscope as a vehicle stabilization sensor. The solid-state gyroscope is a monolithic configuration of a vibrating gyroscopic device. Basic characteristics, such as the zero angular rate null signal, which adversely influence the stability and the sensitivity of the instrument, were investigated. Feasibility models were designed and fabricated, and experienced both performance and environmental evaluations. The results provide a clear determination of the feasibility of the technique for sensing both high and low angular rates while utilizing an extremely small volume, power consumption, weight, and having a maximum reliability. Applications, as well as areas in which future research endeavors should be concentrated, are discussed. Author

N65-16120# Maryland U., College Park. Center for Atmospheric and Space Physics
THE DEVELOPMENT OF AN *IN SITU* PROBE SYSTEM FOR THE MEASUREMENT OF IONOSPHERIC PARAMETERS, VOLUME II
Richard T. Bettinger (Ph.D. Thesis) Jan. 1965 238 p *Its* Tech. Rept.-277 For abstract see N65-16119 06-13
(Contracts AF 19(604)-5575; AF 19(604)-3861; AF 19(628)-2792)
(AFCRL-64-676, Vol. II; AD-609359)

A complete in situ probe system consisting of (1) thermal equalization probes capable of independently measuring vehicle potential; (2) a pulse probe to measure electron concentration and energy distribution and (3) a Langmuir probe that will supply information on positive ion and electron temperatures was designed and tested. This system, along with the requisite telemetry elements was then packaged into an ejectable rocket payload. Preliminary flight test results are presented indicating generally satisfactory operation of the various probes and pointing to a number of design modifications. Vehicle potentials were measured on several flights. Its reaction to DC sweeps, vehicle velocity and solar radiation is demonstrated and discussed. It is concluded that a high energy tail in the normal daytime electron energy distribution exists. Author

N65-16140# Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
FREQUENCY REPEATABILITY OF CRYSTAL IMPEDANCE METER TS-683/TSM
W. Bowerman May 1963 18 p ref
(USAELRDL-TR-2366; AD-412404)

Quartz crystal units, operated within the 10 to 90-Mc frequency range, were subjected to repeated frequency measurements after simulating recalibration of Crystal Impedance Meter TS-683/TSM through readjustment of the oscillation amplitude level and test set frequency under calibration conditions, i.e., with a resistor substituted for the crystal. Generally, it was found that the oscillation frequency of plated AT resonators is critically dependent upon drive, the internal 0-150μA meter cannot be used to adjust drive levels within accurate enough limits, and with a standardized procedure, frequency repeatability of this type C.I. meter (except for frequencies above 75 Mc) is better than 1×10^{-7} Author

N65-16194# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
INVESTIGATION OF USE OF ACCELEROMETERS FOR TRANSIENT DISPLACEMENT MEASUREMENTS Miscellaneous Paper No. 1–672, Jul. 1962–Sep. 1963
Rudy F. Runko Sep. 1964 24 p refs Sponsored by DASA (AD-450999)

This report describes certain techniques used for the twofold numerical integration of accelerometer records. These integration methods are used as aids in obtaining displacement-time histories of structures subjected to nuclear blast effects. Direct displacement measurements cannot be made on such structures because the shock front would remove all stationary references. As a result, seismic-type gages must be used, and the accelerometer has the most favorable range and frequency response for this purpose. Author

N65-16206# Joint Publications Research Service, Washington, D.C.
OPTICO-ACOUSTIC GAS ANALYZERS OF CARBON MONOXIDE, CARBON DIOXIDE AND METHANE, OA2109, OA2209, OA2309. DESCRIPTION AND INSTRUCTIONS FOR ASSEMBLING AND OPERATION, No. 2266-2292 IM
11 Feb. 1965 29 p Transl. into ENGLISH from the publ. "Optiko-Akusticheskiye Gazoanalizatory na Okis' Ugleroda, Dvuokis' Ugleroda i Metan" p 1–25
(JPRS-28710; TT-65-30309)

The gas analyzers described are stationary, automatic recording instruments, and they are designed for continuous measurement of the concentration of carbon monoxide, carbon dioxide, or methane (depending on the particular type of analyzer) in gas mixtures containing those gases, as well as nitrogen, oxygen, and hydrogen, in any amounts. The gas analyzers are described as to their purpose, operating principles, included parts, gas flow, electrical circuit, the design of the receiver, the automatic recorder, and the voltage regulator. Principal specifications are also given. Assembly and operation instructions include the details of assembly, of startup and adjustment, and of operation and adjustment. A troubleshooting chart, showing possible malfunctions and how to eliminate them, is presented. D.E.W.

N65-16262*# Michigan U., Ann Arbor. Radio Astronomy Observatory
INSTRUMENTATION FOR MEASUREMENT OF COSMIC NOISE AT 0.75, 1.225 AND 2.0 Mc/s FROM A ROCKET Technical Report No. 64-15
H. F. Schulte, H. W. Estry, R. L. Miller, and J. W. Kuiper Nov. 1964 116 p
(Contract NASw-54)
(NASA-CR-60502) OTS: HC $4.00/MF $0.75

Design considerations and performance characteristics of a rocketborne instrumentation system for measurements of the radiofrequency noise which originates in the halo of our galaxy are discussed. This system is designed to make simultaneous cosmic noise measurements at frequencies of 0.75, 1.225, and 2.0 Mc, and to measure the radio antenna impedance periodically throughout the flight. The above described instruments were successfully fired to an altitude of 1691 km; the results of the flight will be reported separately. G.G.

N65-16317*# Johnston (W. H.) Labs., Inc., Baltimore, Md.
INSTRUMENTATION FOR THE DETERMINATION OF THE LUNAR ATMOSPHERE Quarterly Report, Jul. 13–Oct. 13, 1964
William H. Johnston 2 Nov. 1964 5 p
(Contract NASw-987)
(NASA-CR-60561) OTS: HC $1.00/MF $0.50

The major effort was expended on the design modifications in the coincidence mass spectrometer for operation in an ultra-high vacuum system. Considerable attention was given to the design of the vacuum system and the bakeout facility. A prototype coincidence mass spectrometer was used in preliminary measurements to aid in the resolution of some of the design problems. Author

N65-16330*# Colorado U., Boulder. Lab. for Atmospheric and Space Physics
A HIGH RESOLUTION ECHELLE SPECTROPHOTOMETER FOR THE SOLAR ULTRAVIOLET Final Report, Aug. 1958–Sep. 1962
W. A. Rense, C. E. Shelden, and E. P. Todd Jul. 1963 118 p refs *Its Sci.* Rept.-2
(Contract NASw-89; NASr-86)
(NASA-CR-53152) OTS: HC $4.00/MF $0.75

The high resolution scanning instrument was designed to record details of the solar hydrogen Lyman-alpha line at 1216 Å from a satellite. The application of the experiment results to problems of solar physics and to problems of the upper atmosphere is discussed. The description of the spectrophotometer includes the optical design, mechanical design, electronics (radiation detector, photomultiplier power supply, data electronics, scanning motor driver, subcommutator, etc.), and the alignment and calibration. Modifications of the satelliteborne spectrophotometer are described to permit its use in an Aerobee sounding rocket; the biaxial pointing control device used is described in detail. Problems encountered during development are discussed, and recommendations are made for their possible solutions. D.S.G.

N65-16333# Federal Aviation Agency, Atlantic City, N.J. Experimentation Div.
TEST OF TRAIL CONE SYSTEM TO CALIBRATE STATIC PORTS FOR BAROMETRIC ALTIMETERS Final Report
Jack J. Shrager Dec. 1964 65 p refs
(RD-64-156)

An experimental trail cone stabilized static source system was fabricated and tested using various towing aircraft at speeds up to 1.12 Mach number to determine its suitability as a standard method for determining altimeter static pressure error. Flight tests were conducted at sea level, 5000, 10000, 15000, 25000, 30000 and 40000 ft, to determine the static pressure defect of the trailing cone system. Test results indicated that the experimental system had a nominal position error equal to ±12 ft at sea level and ±30 ft at 30000 ft. Author

N65-16337# Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Explosives Dept.
ULTRASONIC LIQUID LEVEL INDICATOR
T. Richard Herold and Leslie E. Goodwin Feb. 1964 20 p refs
(Contract AT(07-2)-1)
(DP-863) OTS: $1.00

An ultrasonic reflection technique is described for measuring static or turbulent liquid levels. Although originally developed for closed metal tanks containing process solutions of uranium, plutonium, and fission products, the technique is generally applicable to almost any environment. The ultrasonic transducer, which is positioned vertically by a servo

drive, detects the liquid–air interface and controls the drive by means of the difference in reflectivity of the surrounding medium. A potentiometer coupled to the drive indicates the liquid level on a recorder. In the prototype instrument the readout accuracy was ±0.025 cm over a 46-cm range. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-15454 Picatinny Arsenal, Dover, N.J. · Nuclear Reliability Div.

UNBIASED ESTIMATES OF RELIABILITY WHEN TESTING AT ONLY ONE EXTREME STRESS LEVEL

A. Bulfinch *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 73–91 refs (See N65-15451 06-19)

Based on the stress-strength concept of reliability for "one-shot" items, it is assumed that an item cannot fail until the stress equals or exceeds the strength. From this premise and the following additional assumptions, methods are given for calculating unbiased estimates of nontime-dependent reliability: (1) The relation between the stress and strength standard deviations is known approximately. (2) A single-stress level is applied during testing at approximately three standard deviations from the average stress level. (3) The stress and strength distributions are normal. Calculations are included to show the effect of errors in the assumptions concerning the standard deviations, applied stress level, and rounding-off errors. This approach further reduces the sample size required to demonstrate high nontime-dependent reliability in laboratory testing. It has the added advantage of obtaining unbiased estimates of reliability with the simplest of testing methods. Author

N65-15458 Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center

STATISTICAL TESTING TECHNIQUES USED IN THE DEVELOPMENT OF THE PRATT & WHITNEY AIRCRAFT RL10 ROCKET ENGINE FOR THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Harold J. Tiedemann *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 193–203 (See N65-15451 06-19)

Testing techniques, the best areas of their application, and their successful use in the RL 10 engine development program are described. These techniques include: (1) full factorial testing to determine thrust-control setting repeatability; (2) a partial full factorial test program to provide additional fuel pump stall margin; (3) a Latin Square test program designed to determine the principal factors in controlling transient thrust overshoot; and (4) a random balance test to determine methods for control of thrust-control hysteresis and nonlinearity. Certain guidelines for statistical testing techniques are presented. D.S.G.

N65-15465 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.

RELIABILITY CONCEPTS FOR MISSILE BATTERIES

Nicholas T. Wilburn *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 307–317 (See N65-15451 06-19)

Methods of determining the reliability of one-shot battery power supplies for missile guidance, control, or warhead systems are discussed. The first method involves testing at four times the specified g level of a dynamic environment; mechanical weaknesses which can be corrected through redesign can be uncovered by this method, but statistical prediction of the probable failure rate cannot be made. The second method contains all the elements of the first plus an analysis of the variance of performance parameters, assuming that the parameters are normally distributed. The value of the reliability prediction depends on the validity of that assumption. The third method involves testing at the specified g level instead of the arbitrary multiple of four, but presents no advantages over the previously described methods. The fourth method approaches the problem of reliability by determining the actual mean failure points with respect to each environmental factor in sequence; interactions between stresses are not considered. The last method is based on the determination of mean failure points and, based on analysis of variance, predicting probability of failure at the requirement stress levels, actual failure need not be induced. The advantages and disadvantages of these methods are presented. D.S.G.

N65-15471 Aberdeen Proving Ground, Md. Army Ballistics listics Research Labs.

STATISTICAL STUDY OF RELIABILITY AND ACCURACY OF SURFACE-TO-AIR MISSILES

Bruce W. Sterner *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 537–540 refs (See N65-15451 06-19)

An abridged paper containing unclassified portions of two confidential reports is presented. The original work, the subject of the original two papers, consisted of the statistical study of data derived from troop training flights of Nike Hercules and Hawk missiles, with particular emphasis on reliability, failure modes, and the analysis of miss distance data. The program for statistical analysis is outlined in general, and contributions of the program to the Army stockpile surveillance effort are cited. D.E.W.

N65-15476 Aberdeen Proving Ground, Md. Ballistic Research Labs.

STATISTICAL STUDY OF AGING CHARACTERISTICS OF ARTILLERY MISSILES

Raymond Bell *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 623–647 (See N65-15451 06-19)

A typical analysis of service practice firing results for artillery missiles is presented, and the significance of these results in the surveillance program is indicated. Two possible changes in the accuracy performance of the M31 rocket were considered: changes in the center of impact of the rockets as a function of age, and changes in the dispersion of the rockets about the center of impact as a function of age. The results of the analyses indicated that there appears to be significant age effect on the functioning results of the M31 Series Honest John Rocket. Average range decrease per year of age is presented and discussed. The dispersion about the displaced centers of impact seemed to be systematic, rather than erratic. D.E.W.

N65-15533*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF 40-MILLIMETER-BORE BALL BEARINGS OPERATING IN LIQUID OXYGEN AT DN VALUES TO 1.2 MILLION
Robert E. Cunningham and William J. Anderson Washington, NASA, Jan. 1965 22 p refs
(NASA-TN-D-2637) OTS: HC $1.00/MF $0.50

An experimental investigation was undertaken to evaluate the performance of two series of ball bearings (extra light 108 and extremely light 1908) suitable for cryogenic turbopump applications. These bearings were tested fully immersed in liquid oxygen at radial loads from 100 to 600 pounds and at DN values (bearing bore in mm times shaft speed in rpm) to 1.2 million. The maximum running time accumulated on any one bearing was 19.7 hours. Bearing-torque and wear data were obtained on seven different retainer materials to compare their influence on overall bearing performance. The three different glass-reinforced-Teflon retainer materials that gave the best overall performance were: (1) molybdenum disulfide plus glass fiber in Teflon; (2) glass fiber in Teflon; and (3) glass-cloth–Teflon laminate. Generally, the friction and wear results obtained corroborate earlier friction and wear studies in liquid nitrogen. Author

N65-15541# General Electric Co., Owensboro, Ky. Tube Dept.
C-BAND TRIODE-CAVITY OSCILLATORS PRODUCTION ENGINEERING MEASURE Quarterly Progress Report, 1 Jun.–31 Aug. 1964
J. D. Marshall [1964] 21 p
(Contract DA-36-039-AMC-01474(E))
(QPR-5; AD-607665) OTS: $2.00

Work is reported on a project to optimize performance of the triode-cavity combination, to improve manufacturing methods and product uniformity, to minimize the cavity physical size, and to produce 5 units per day in a production facility. During this period, the final versions of the test specifications were drawn up and approved; and the assembly and testing of the sample representing the preproduction run were completed. Tests are specifically reported for the cw oscillator and for the pulsed oscillator. The fabrication of triodes for the pilot production phase was completed. D.E.W.

N65-15562# Boeing Co., Seattle, Wash. Aero-Space Div.
MACROLAMINATE PARTICLE COMPOSITE MATERIAL DEVELOPMENT Interim Report, 1 Oct.–1 Dec. 1964
F. H. Simpson and L. M. Stejskal [1964] 36 p
(Contract NOw-64-0194-f)
(IR-4; AD-454941)

Flexural, compressive, and oxidation tests were completed on specimens made from laminate sheets with dimensional and compositional variations. Flexural strengths varied between 27.5 and 80 ksi; compressive strength varied from 93.4 to 156.2 ksi; compressive deformation varied from 5.4% to 14.3%; and weight loss due to oxidation at 2500° F after 24 hr varied from 232 to 943 mg/cm^2. Flexural strength of the composite increases rapidly when layers in the laminate particles are less than 0.001 in. thick. In general, compressive deformation increases with increasing metal content, while compressive strength and oxidation resistance decrease. Properties of the composites were found to vary more due to the mechanics of the knife coating operation than to the variables of layer thickness and metal-to-ceramic ratio at layer thickness greater than 0.001 in. Author

N65-15563# Bendix Corp., South Bend, Ind. Bendix Products Aerospace Div.
DEVELOPMENT OF IMPROVED STRENGTH AND OXIDATION RESISTANCE IN CHROMIUM COMPOSITES Quarterly Report, 17 Jun.–16 Sep. 1964
Wayne A. Farrington and Robert V. Watkins 12 Oct. 1964 22 p refs
(Contract NOw-64-0321-c)
(QR-2; AD-450332)

The work accomplished aimed at the development of improved high-temperature strength, oxidation resistance, and room-temperature ductility of chromium–ceramic composites. It includes a continuation of oxidation studies and a study of alloying effects of various elements. Supplemental oxide additions, including alumina and spinel, did not effect a substantial increase in oxidation resistance, while alloying elements displayed varied effects. Silicon tended to slightly increase the oxidation resistance. Hardness increases were displayed in binary alloys containing varied amounts of 11 alloying elements. Author

N65-15595# Army Tank-Automotive Command, Center Line, Mich. Land Locomotion Lab.
BEHAVIOR OF PNEUMATIC TIRE
P. W. Haley Jun. 1964 20 p
(Rept.-8521; AD-450399)

The existing fundamental equations that are used to describe the performance of a wheel operating in soft soils require modification if they are to accept a deforming pneumatic tire. These modifications are based on new variables characteristic to the tire, including tire deflection, carcass stiffness, and inflation pressure. The proposed program calls for the testing of driven pneumatic tires under various load, slip inflation pressure, and soil conditions. Using these variables as input data, drawbar pull, slip, deflection, rolling resistance, and drive torque are to be measured. Described are the evaluation and modification of the existing test apparatus. Preliminary test runs indicated a need for remodifying the design of the apparatus. The problems encountered with the apparatus are discussed. Author

N65-15596# Army Tank-Automotive Command, Center Line, Mich. Land Locomotion Lab.
THE SHEAR TO NORMAL STRESS RELATIONSHIP BETWEEN A RIGID WHEEL AND DRY SAND
Aharon D. Sela Jun. 1964 71 p
(Rept.-8524; AD-450398)

Analytical expressions were formulated to describe the distribution of shear stresses that arise due to slip and soil flow. The distribution of the shear and normal stresses along the wheel-soil interface was established as a function of slip. The stresses under a towed wheel are also described. Actual measurements of the stresses by means of a special transducer embedded in the wheel are presented, and are compared to theoretical values. It was found that the agreement is satisfactory. It is concluded that further analysis of the available data will lead to a better understanding of the machanics of tires operating off the road, and to an improvement in wheeled-vehicle prediction techniques. Author

N65-15655# Naval Applied Science Lab., Brooklyn, N.Y. Material Sciences Div.
PROPERTIES OF ELECTRON BEAM WELD JOINTS IN ONE INCH THICK Ti-721 ALLOY TITANIUM PLATE Progress Report

Herbert Nagler, Joseph R. Crisci, and Alfred L. Frank 23 Oct. 1964 32 p
(PR-3; AD-451264)

Presented are the results of a study to fabricate and determine the properties of electron-beam butt welds in thick Ti-7Al-2Cb-1Ta alloy titanium plate. Weld strength, toughness, and bend properties comparable to base plate and inert gas metal arc fusion welds were achieved in the top half of the weld. Lack of fusion at the weld root tended to degrade the properties of the bottom of the weld. Further refinement of techniques appears to be necessary to avoid lack of fusion at the root of the weld and to improve the contour of the weld bead. Although the size of electron-beam weldments is presently limited by the size of available vacuum chambers, this limitation may be overcome by the use of portable vacuum chambers or by development of out-of-vacuum electron-beam welding systems. Author

N65-15656# McDonnell Aircraft Corp., St. Louis, Mo.
UNPUBLISHED MATERIALS RESEARCH AND DEVELOPMENT PROGRAMS Second Semiannual Summary Report
10 Jun. 1964 187 p
(Contract AF 33(657)-11215)
(A758; AD-441136)

The mechanical, physical, chemical, and miscellaneous properties of various metals, plastic materials, rubber materials, lubricants, and heat-transfer fluids were investigated. The effects of a corrosive environment and/or elevated temperatures on the properties of organic and inorganic finishes, surface conditioning treatments, and chemical finishes, as well as the effects of inorganic finishes on the properties of refractory metals were also studied. Brief summaries are given for each study, and the resulting data are presented. Included is a contents index code of the current test programs. G.G.

N65-15674# Joint Publications Research Service, Washington, D.C.
UNIVERSAL STAND FOR AUTOMATIC WELDING ON LONGITUDINAL SEAMS OF SHELLS AND SHEETS
Ye. N. Skopinov, A. A. Kurkumeli, and Ye. V. Mokhovikov 1 Feb. 1965 4 p Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow), no. 10, Oct. 1964 p 42
(JPRS-28563; TT-65-30245) OTS: $1.00

A welding stand is described that is adaptable for the automatic welding of several different shapes of thin metallic materials. Procedures are given for thin sheet, pipes, and shells of steel; and adaptations are described for the stand to be used in welding thin sheets of stainless steel, aluminum, titanium, and their alloys, using a protective gas shielding on the back side of the weld. D.E.W.

N65-15675# Joint Publications Research Service, Washington, D.C.
BRAZING SHORT-CIRCUITED ROTORS OF ASYNCHRONOUS ELECTRIC MOTORS WITH AN MPR-100 MACHINE
B. M. Nekrasov, G. I. Zlobin, and Yu. A. Rusakov 1 Feb. 1965 5 p Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow), no. 10, Oct. 1964 p 39–40
(JPRS-28564; TT-65-30246) OTS: $1.00

A machine for the automatic brazing of large short-circuited rotors is described. The complete specifications of the machine are given, including the sizes of rotors that can be brazed in it, the rate of productivity, voltage, power, machine dimensions, machine weight, etc. The procedures that the machine follows in this manufacturing step are described briefly, and the influence on production efficiency of this machine is given. D.E.W.

N65-15680# Joint Publications Research Service, Washington, D.C.
BRAZING STAINLESS STEELS AND HEAT-RESISTING ALLOYS
A. I. Gubin 1 Feb. 1965 131 p refs Transl. into ENGLISH of the book "Payka Nerzhaveyushchikh Staley i Zharoprochnykh Splavov" Moscow, 1964 p 1–128
(JPRS-28572; TT-65-30250) OTS: $4.00

The subjects covered are: (1) *Design of Stainless Steel and Heat-Resisting Alloy Braze Joints;* (2) *Brazing Preparations;* (3) *Brazes for Stainless Steels and Heat-Resisting Alloys;* (4) *Brazing Fluxes and Gas Media;* (5) *Brazing Methods;* (6) *Quality Control of Braze Joints;* and (7) *Safety Engineering in Melting Brazing Alloys and in Brazing.* R.L.K.

N65-15682# Joint Publications Research Service, Washington, D.C.
BRAZING OF THIN-WALLED PIPING
A. I. Gubin and A. N. Kitayev 2 Feb. 1965 57 p Transl. into ENGLISH from the book "Svarka i Payka Tonkostennykh Truboprovodov" (Moscow), 1964 p 55–109
(JPRS-28594; TT-65-30259) OTS: $3.00

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1. TECHNOLOGY OF BRAZING OF PIPING p 1-29
2. TREATMENT OF PIPING SURFACES p 30–36
3. STRENGTH OF WELDED AND BRAZED PIPING UNIONS p 37–55

N65-15700# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
ELECTRODEPOSITED, ELECTROLESS, AND ANODIZED COATINGS ON BERYLLIUM
John G. Beach 1 Sep. 1964 14 p refs
(Contract AF 33(615)-1121)
(DMIC-Memo-197; AD-438432)

Because of expanding interest in the uses for beryllium, information was summarized on surface finishing and coating of this metal. Its light weight and high modulus favor beryllium as a structural material for aerospace needs. The performance of beryllium is benefited by preferred surface finishing and coatings. Available information is presented on electroless, electrodeposited, and anodized coatings on beryllium. Author

N65-15712*# IIT Research Inst., Chicago, Ill. Technology Center
DEVELOPMENT OF SPACE-STABLE THERMAL-CONTROL COATINGS (PAINTS WITH LOW SOLAR ABSORPTANCE/EMITTANCE RATIOS) Triannual Report, 20 Sep. 1963-20 Jan. 1964
Gene A. Zerlaut, E. H. Tompkins, and Y. Harada 5 Mar. 1964 62 p refs
(Contract NAS8-5379; IITRI Proj.-C6014)
(NASA-CR-60355; IITRI-C6014-8) OTS: HC $3.00/MF $0.75

A porous, methyl silicone coating with a solar absorptance of 0.11 has been formulated by leaching a finely divided salt from the silicone matrix with water. The limitations to the use of microbubbles as scattering systems appear to be the stabilities which can ultimately be achieved with polymeric films. The principal problem currently being investigated is enhanced degradation of the polymer matrix due to deep scattering. Pigment mixing studies employing zinc oxide and a secondary, ultraviolet-reflecting pigment were generally unsuccessful in improving the ultraviolet reflectance of corresponding paints. In some instances the secondary pigment not only failed to

improve ultraviolet scattering but also had an adverse effect on the scattering of zinc oxide at longer wavelengths. Overlayers of ultraviolet-reflecting paints appear to hold some promise for decreasing the solar absorptance of zinc oxide paints. The principal problem with topcoats such as zircon, zirconia, or Lithafax will be the competition between coatings thick enough to provide reflectance reinforcement and thin enough not to detract from the ultraviolet stability. Author

N65-15761# Eitel-McCullough, Inc., San Carlos, Calif.
METALLURGICAL RESEARCH AND DEVELOPMENT FOR CERAMIC ELECTRON DEVICES Ninth Quarterly Report, 1 Jul.–30 Oct. 1964
L. Reed, W. Wade, and S. Vogel [1964] 52 p refs
(Contract DA-36-039-SC-90903)
(TR-64-39; AD-453867)

The experimental setup and procedures for absolute calorimetric measurements of radio-frequency dissipation in dielectric-to-metal seals are described. Seals of rectangular windows in waveguides were simulated with dielectric frames metalized and brazed to the waveguide walls. Six different seals were investigated and the measured dissipation was extrapolated to the case of resonant slab windows. At X-band, seal dissipation amounted to about 20% of the total dissipation in a window assembly. The results of the seal parameter study are discussed. The relative importance of the ceramic, metalizing, plating, braze, and metal member in contributing to seal strength, vacuum tightness, and durability are considered. Most seals were found to fail in the brittle material zones, the ceramic and the metalizing. A form of mechanical interlocking between the ceramic and metalizing was present in all seals with tensile strength above 10000 psi. No direct verification of chemical bonding was obtained, but many seals with tensile strength between 5000 and 10000 psi apparently had no other means of adhesion. Author

N65-15776# Ohio State U. Research Foundation, Columbus.
RESEARCH ON RADIOGRAPHIC TECHNIQUES OF GRAPHITE EVALUATION Technical Documentary Report, 1 Jun. 1963–31 May 1964
Merle L. Rhoten Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1964 100 p refs
(Contract AF 33(657)-11245)
(ML-TDR-64-277; AD-609877)

Technique charts are presented for the radiography of graphite in the medium thickness range 2 to 14 inches, using typical industrial X-ray equipments. Results of experimental data presented in this report, demonstrate the problems in the radiography of graphite which are due to scatter radiations and the economics of inspection. The thicknesses of graphite billets (now ranging up to 103 inches) present geometrical unsharpness problems as related to economy of inspection. When the X-ray source is removed from the film sufficient distances to obtain a reasonable D/T ratio, exposure times become uneconomical. Techniques reported also demonstrate that better than 1 percent radiography can readily be obtained using typical industrial techniques and lead filtering, for the ranges of thicknesses from 1/2 to 40 inches. Author

N65-15778# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
ELECTRONIC PARTS ACCELERATED LIFE TESTS Final Report, 31 Jan. 1963–30 Jan. 1964
P. H. Greer Griffiss AFB, N.Y., RADC, Oct. 1964 170 p
(Contract AF 30(602)-2970)
(RADC-TDR-64-142; AD-609808)

The purpose of this effort was to investigate and develop test measurement techniques to controllably accelerate aging of silicon epitaxial planar transistors and to empirically determine a linear equation relating stress factors, environmental tests, and operating life tests, thereby making it possible to predict the reliability of these transistors. A total of 4265 PNP type 2N1132 transistors were used. Summaries of the results of step–stress tests, operating life tests, environmental tests, and matrix test are presented. Analysis of these test results with estimated acceleration factors, failure rates, and parameter distribution and stability plots is also presented. Important conclusions resulting from the tests completed, along with recommendations of areas in which additional studies might be pursued to obtain a better method of transistor reliability prediction and measure are given. Author

N65-15911# Linde Co., Indianapolis, Ind. Engineering Dept.
DEVELOPMENT AND APPLICATION OF CRYOSORPTION PUMPING OF HYDROGEN AT 20°K BY MOLECULAR SIEVE ADSORBENT PANELS
P. J. Gareis and J. R. Pitlor Arnold AF Sta., Tenn., Arnold Eng. Develop. Center, Jan. 1965 114 p refs
(Contract AF 40(600)-944)
(AEDC-TR-65-18; AD-455375)

An experimental and theoretical investigation of the vacuum pumping of hydrogen by refrigerated panels consisting of Molecular Sieve 5A bonded to metallic substrates was performed in the pressure range of 10^{-9} to 10^{-6} torr. Initial sticking coefficients approximating unity were obtained with an array utilizing a shield and panel configuration, both refrigerated to 20° K. An effective, practical, initial activation procedure was developed for utilization with the shielded array wherein desorbed water vapor was cryopumped by the liquid nitrogen cooled elements surrounding the 20° K surfaces. Successive tests with a particular panel produced a progressive reduction in pumping speed. Methods were developed that resulted in partial recovery of prior pumping speed values; however, further effort is required to define precise conditions of efficient, successive activation procedures capable of maintaining the initial high sticking coefficient values. A theoretical model is presented that relates observed pumping speed results to diffusion parameters of the cryosorption pumping mechanism. Criteria are discussed for application of cryogenic arrays, utilizing cryopumping and cryosorption, as practical ultrahigh vacuum pumping units. Author

N65-15924# Frankford Arsenal, Philadelphia, Pa. Research and Development Directorate
PRESSURE CASTING IN INVESTMENT MOLDS
Samuel Lipson and Fred Ripkin 6 Oct. 1964 21 p refs
(A64-20; AD-451230)

A study was made of methods for pressure casting nonferrous alloys into investment molds. The experimental methods were compared with standard suction casting practices. The best method studied was the Direct Pressure Diaphragm Method. By this method, metal is forced into the mold in an upward direction with a high degree of control of metal stream velocity, turbulence, and casting pressure. Fluidity tests showed that improved filling of the casting section could be realized. Tensile tests showed that the incidence of defects in the casting cross section could be substantially reduced. These effects were attributed to the attainment of lowered metal turbulence. Examples of large thin-sectioned aluminum castings are shown to demonstrate the utility of the process for so-called problem castings. Author

N65-15986# SKF Industries, Inc., King of Prussia, Pa. Research Lab.
INFLUENCE OF LUBRICATION ON ENDURANCE OF ROLLING CONTACTS Final Summary Report, Jun. 22, 1961–Jun. 22, 1964
K. Tataiah et al [1964] 197 p refs
(Contract NOw-61-0716-c)
(AL64T067; AD-609437)

A study of elastohydrodynamic lubricant film effects in rolling ball two-ball contacts is presented. Mineral oils, ester base, and polyphenyl ether lubricants with and without lubricity additives were studied. The experimental work covered the development and application of contact conductivity and X-ray beam transmission measurements for film thickness and profile determination, radiotracer wear rate determination, microautoradiography of wear debris and of metal transfer, instrumental analysis of surface microgeometry; and rolling contact fatigue test series. A tentative analysis of wear debris size distribution is given. Microautoradiography is used to show that there is direct metal transfer in lubricated sliding ball contact, but only wear debris redeposition from the lubricant in rolling contact. Some measurements of film thickness and shape by X-ray beam transmission are reported. Author

N65-15991# Brunswick Corp., Marion, Va. Defense Products Div.
DEVELOPMENT OF A 1200°F RADOME Interim Engineering Report, 1 Jul.–30 Sep. 1964
V. A. Chase and R. L. Copeland [1964] 39 p
(Contract AF 33(657)-11469)
(IER-6; AD-607728)

This report involves investigation into new matrices and laminate processing improvements. Additional information is reported on the effect of curing atmospheres on laminate strength. Curing under nitrogen extends the life of the protective coating at elevated temperatures, but for less than 100 hours. Mechanical and electrical properties data on the improved composite are reported. The mechanical strengths were markedly improved through the matrix-processing investigation. Initial results on the filament-winding feasibility study are presented, and they indicate a potential for this type of reinforced ceramic composite. Author

N65-15997# Northrop Corp., Hawthorne, Calif. Norair Div.
DEVELOPMENT OF MANUFACTURING CAPABILITY FOR PRODUCING HIGH PERFORMANCE ALUMINUM AND MAGNESIUM ALLOY CASTINGS Quarterly Progress Report No. 2, 1 Aug.–31 Oct. 1964
A. J. Iler Nov. 1964 36 p refs
(Contract AF 33(615)-1341)
(NOR-64-278; AD-608290)

Developmental work is described on the Mg-Zn-Ag-Zr alloys, on the aluminum alloys ST60 and M710, on a modified aluminum alloy 195, on configuration patterns, and on the first founding experience in the alloys. Development and evaluation of foundry processing methods are presented as related to most advanced techniques, with further development of those offering the most potential, and selection and evaluation of the most promising magnesium- and aluminum-base alloys. The trial production phase used one magnesium and one aluminum alloy for experimental castings and testing of the resulting castings. The pilot production produced 25 aluminum and 25 magnesium castings for testing metallurgically, environmentally, and statistically. Correlated test data were tabulated. R.E.S.

N65-16000# Metals and Controls, Inc., Attleboro, Mass.
STUDY OF DUCTILE COATINGS FOR THE OXIDATION PROTECTION OF COLUMBIUM AND MOLYBDENUM ALLOYS Final Report, 1 Jul. 1963–30 Jun. 1964
J. J. Buchinski and E. H. Girard Oct. 1964 127 p refs
(Contract NOw-63-0706-c)
(AD-608135)

Platinum and Pt–10% Rh were examined as potential ductile oxidation resistant coatings for FS-85 (Cb–28Ta–10W–1Zr) and TZM (Mo–0.5Ti–0.1Zr). Oxidation tests on coating materials showed that 2-mil thicknesses would provide over 100 hours of protection up to 3000°F in the absence of diffusion degradation. Roll bonded and hermetically sealed binary composites were evaluated for oxidation and diffusion behavior. Coating lifetimes of 5 to 15 hours at 2550°F were attained before diffusion-induced failure occurred. No significant differences were observed between static and cyclic oxidation behavior. Failure mechanisms of FS-85 and TZM compositions were shown to be substantially different from each other. Six materials were evaluated in screening tests for potential diffusion barriers. Only ZrO_2 showed any merit, while Re, Au, Al, Bn, and $A1_2O_3$ did not. Author

N65-16007# Air Force Cambridge Research Labs., Bedford, Mass.
A METHOD FOR ELECTROCUTTING SINGLE CRYSTALS OF METALS AND ELECTROPOLISHING THE EXPOSED CRYSTALLINE FACE
Bernard Rubin and John J. O'Connor Dec. 1964 13 p refs
Its Instrumentation Papers No. 53
(AFCRL-64-957; AD-610069)

To minimize the introduction of physical defects into soft crystals during cutting or slicing operations, a technique was developed for electrocutting and electropolishing ingots where electrochemical dissolution is used. Copper crystals were masked to expose the area to be cut and, using an electrolyte of copper dihydrogen phosphate, anodic dissolution exposed the desired surface. The resulting surface was electropolished to expose the desired face for later use as an epitaxial substrate. Author

N65-16024# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
METAL DEFORMATION PROCESSING, VOLUME I
F. W. Boulger, M. Baldwin, Jr., A. H. Clauer, J. A. Houck, M. J. Klein et al 14 Aug. 1964 136 p refs
(Contract AF 33(615)-1121)
(DMIC-208; AD-608637)

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3. THERMAL MECHANICAL VARIABLES AFFECTING THE PROPERTIES OF REFRACTORY METALS AND ALLOYS J. A. Houck and H. R. Ogden p 62–71 refs
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8. STRAIN AGING M. J. Klein and C. N. Reid p 114–126 refs

N65-16042# Astropower, Inc., Newport Beach, Calif.
COMPATIBILITY OF STRUCTURAL MATERIALS WITH HIGH PERFORMANCE O-F LIQUID OXIDIZERS Quarterly Progress Report, 15 Jun.–15 Sep. 1963
W.D. English, S.W. Pohl, and N.A. Tiner [1964] 76 p
(Contract AF 33(657)-9162)
(Rept.-112-Q5; AD-422742)

This is a report on the compatibility of structural materials with oxygen fluoride, perchloryl fluoride–tetrafluorohydrazine (1:1) blend, and ozone fluoride-LO_2 solutions. Further exposure tests were performed with OF_2 and $FClO_3$-N_2F_4. Initial stress corrosion tests with these oxidizers were carried out. First corrosion tests in O_3F_2-LO_2 were completed. Author

N65-16050# National Academy of Sciences—National Research Council, Washington, D.C. Engineering and Industrial Research Div.
PROCEDURES FOR EVALUATING COATED REFRACTORY METAL SHEET
Walter R. Hibbard, Jr. 3 Aug. 1964 42 p refs
(Contract ARPA SD-118)
(MAB-201-M; MAB-189-M; AD-605453) Supersedes MAB-189-M; See X63-11350

The definition of a set of test procedures is presented to permit a comparison of coating systems. A review is presented of previous standards and a change has been added in a procedure to determine temperature stepdown oxidation characteristics. The areas in which parameters have been established are: oxidation characteristics of both furnace and oxyacetylene flame heating; the effects of coating process and coating on bend transition temperature of alloy; the advantages, disadvantages, and limitations of a system in terms of producibility and compatibility. Advanced evaluation procedures determine parameters for: oxidation in reduced-pressure flowing air; tensile tests at room temperature and at elevated temperatures; stress rupture and creep tests with specimen dimensions before and after coating; coating tolerance for tensile prestrain with the criteria of the retention of oxidation protection; fatigue testing at room temperature using tension-tension loading with calculations on the original uncoated metal. A test for optical temperature measurement is described with well-calibrated parameters for both total radiation and optical radiation. An apparatus is described for reduced pressure oxidation testing for coated refractory metals. The requirements for high temperature mechanical testing are discussed in terms of heat sources and strain measurement. R.E.S.

N65-16116# Universal-Cyclops Steel Corp., Bridgeville, Pa. Refractomet Div.
WELDING OF REFRACTORY METALS Final Report, 28 Sep. 1962–30 Apr. 1964
L.M. Bianchi, W.A. Mc Neish, and F.D. Seaman Jul. 1964 240 p
(Contract NOw-63-0043-c)
(AD-608818)

This report presents a study of the effects of welding variables on refractory metals and indicates the degree and magnitude of control of the variables necessary for the improvement of production welds in refractory metals. The flexibility of InFab as a large inert atmosphere chamber suitable for welding refractory metals was evaluated. The ability of a welder to accomplish out-of-position manual welds in InFab was demonstrated. A limited investigation indicated improved resistance welds may be produced by inert atmosphere protection. Author

N65-16124# Pratt and Whitney Aircraft, East Hartford, Conn.
SOLID FILM LUBRICATED BEARING RESEARCH PROGRAM Technical Documentary Report, 1 May 1963–30 Jun. 1964
Paul Brown, Roger M. Hawkins, M. Maguire, and M. Pitek Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1964 211 p refs
(Contract AF 33(657)-10420)
(PWA-2354; FDL-TDR-64-117; AD-608629)

The program was divided into two phases. The first phase consisted of analytical evaluations of potential bearing designs, solid lubricant materials and lubricant supply systems as applied to accessory-sized ball bearings. The second phase was devoted to laboratory determinations of lubricant materials tensile strength and thermal properties followed by evaluations of selected solid lubricant materials and bearings. These tests included friction and wear evaluations of both lubricant and bearing materials in a friction and wear rig; evaluations of full-scale bearings in atmospheric and vacuum environments at temperatures ranging from −249° to 1500° F, at speeds up to 24000 rpm for periods up to 3 hours; and vacuum-environment testing of bearings that were exposed to a fast neutron dose of approximately 1.0×10^{17} neutrons/cm^2 (>1.0 MeV). Test results indicated that no lubricant tested, regardless of the supply system used or conditions under which tested, showed any clear superiority when compared to other dry film lubricants. Author

N65-16176# Spindletop Research Center, Lexington, Ky.
FEASIBILITY OF CONTINUOUS FORMING OF BORON CARBIDE MONOFILAMENTS Final Report
William E. Kuhn and Victor C. Woodworth 28 Jan. 1965 26 p refs
(Grant NsG-680)
(NASA-CR-60498) OTS: HC $2.00/MF $0.50

An experimental investigation of the feasibility of producing boron carbide fibers by a continuous coating technique is discussed. Boron carbide was melted on a water-cooled copper hearth in an argon atmosphere, using an induction generator at a frequency of 450 kc/sec. A partial coating of boron carbide was produced on a carbon filament by drawing it through molten boron carbide. The major variable in the coating process was isolated and identified as the dwell time of the fiber within the melt. R.E.S.

N65-16201*# Mechanical Technology, Inc., Latham, N.Y.
LUBRICATION ANALYSIS IN TURBULENT REGIME Second Quarterly Report
F.K. Orcutt, C.W. Ng, J.H. Vohr, and E.B. Arwas 30 Jan. 1965 82 p refs
(Contract NASw-1021)
(NASA-CR-54259; MTI-65TR2) OTS: HC $3.00/MF $0.75

The preloaded tilting-pad bearing was tested experimentally. Measurements of static load capacity and shaft response to dynamic loading agreed very well with calculated values, and the theoretical results were quite adequate for design analysis. Measured torques were uniformly higher than the calculated values. The analysis for static load properties of the floating-ring bearing was completed, and some numerical results are presented. Apparatus modification and preliminary experiments are reported on some studies of fundamental processes of superlaminar flow in concentric and eccentric annuli. D.E.W.

N65-16212# Sandia Corp., Albuquerque, N. Mex.
INTERFACE FORMATION AND THE ADHESION OF DEPOSITED THIN FILMS
D. M. Mattox Jan. 1965 20 p refs
(SC-R-65-852) OTS: $1.00

A discussion is given of the types of interfacial regions that may be formed between a film and a substrate. Various deposition techniques are compared as to their ability to form the various types of interfacial regions. The mechanism of failure of the bond between film and substrate is discussed in terms of the type and structure of the interfacial region. The reasons for poor adhesion are discussed, and approaches for overcoming adhesion problems are presented. The deposition process of ion plating is presented as one technique for overcoming many adhesion problems. Author

N65-16230# National Lead Co. of Ohio, Cincinnati. Feed Materials Production Center
[URANIUM PRODUCTION TECHNIQUES AND CASTING METHODS FOR NUCLEAR REACTOR FUEL CORES] Summary Technical Report, Oct. 1–Dec. 31, 1964
S. Marshall and R. Burgett 10 Feb. 1965 50 p refs
(Contract AT(30-1)-1156)
(NLCO-940) OTS: $3.00

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5. THE CHEMICAL SEPARATION OF RARE EARTHS FROM URANIUM—A RADIOACTIVE TRACER EVALUATION G. R. Blank, B. L. Twitty, and W. H. Dingeldein 9 p refs
6. ONE-PIECE ANODE-CUP ELECTRODES FOR THE CARRIER DISTILLATION EXCITATION OF IMPURITIES IN U_3O_8 A. J. Pardi and W. H. Dingeldein 4 p ref
7. DETERMINATION OF THE TRANSFORMATION TEMPERATURES OF DILUTE ALLOYS OF URANIUM BY DIFFERENTIAL THERMAL ANALYSIS S. F. Paris 4 p refs
8. CONVERSION OF AN OPTICAL MICROSCOPE TO MEASURE THE REFLECTANCE OF GRAINS IN METALLIC SAMPLES W. W. Brock and J. W. Colby 4 p ref

N65-16231*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
AN EVALUATION OF VAPOR-DEPOSITED TUNGSTEN TUBING Topical Report
R. G. Mills, J. R. Lindgren, and A. F. Weinberg Cleveland, NASA. Lewis Res. Center, 19 Oct. 1964 39 p
(Contract NAS3-4165)
(NASA-CR-54277; GA-5721) OTS: HC $2.00/MF $0.50

Tests were performed on 17 samples of vapor-deposited tungsten tubing. It was concluded that: (1) The chemical impurity content was comparable. (2) The metallic impurities were at a low level. (3) A positive correlation existed between the residual fluoring content and the ductile-to-brittle transition temperature. (4) Extruded tungsten tubing had a low fluorine content. (5) The lowest fluorine content of vapor-deposited tubing was comparable to that of the extruded tubing. (6) Tubes of stable structure showed little grain growth. (7) Highly oriented deposited columnar structures showed less grain growth than the less oriented deposited structure. (8) Grain growth of vapor-deposited tubing was not primarily related to the chemical impurity content. (9) Extensive grain growth took place in extruded tubing during heat treatment. (10) The ductile-to-brittle transition temperatures of extruded tubing and of vapor-deposited tubing were comparable. (11) There was no correlation between hardness and any other variable. R.E.S.

N65-16237# Atomic Energy Commission Research Establishment, Riso (Denmark).
METALLURGY SECTION ANNUAL PROGRESS REPORT FOR THE PERIOD ENDING MARCH 31, 1964
Aug. 1964 54 p refs
(Riso-90; AD-451681)

Work was continued on the development of a prototype fuel element for the Riso reactor project DOR. This fuel element is made up of 19 fuel rods, each consisting of a finned sintered aluminum powder (SAP) tube filled with pellets of sintered uranium dioxide. The investigation of the SAP materials comprised heat treatments and destructive testing, especially creep testing at temperatures from 400° to 500° C. The influence of neutron irradiation on the mechanical properties of SAP was examined. Finally, the compatibility of SAP with uranium dioxide and uranium carbide was determined at temperatures from 450° to 600° C. On the basis of all these experiments with SAP, it was concluded that SAP may be considered a satisfactory construction material for the organic-cooled reactor. The work on uranium dioxide included the development of a pilot process for manufacturing-dioxide pellets, involving the design and construction of equipment for continuous reduction and sintering. Author

N65-16244# Westinghouse Electric Corp., Philadelphia, Pa.
PRODUCTION ENGINEERING MEASURE: TYPE 2N1814 SILICON ALLOY TRANSISTOR Quarterly Progress Report, 1 Jul.–30 Sep. 1964
T. E. Ebert, R. J. Pisarcik, and W. E. Shopsky [1964] 25 p
(Contract DA-36-039-AMC-03617(E))
(QPR-5; AD-609260)

The status of all of the process improvements is presented. Progress and data are reported for the pulsed peak power test program. Additional life test data are given for standard 2N1814 production units. Author

N65-16261*# Pyrogenics, Inc., Woburn, Mass.
A STUDY OF THE USE OF VAPOR AND VACUUM DEPOSITION TECHNIQUE FOR THE DEVELOPMENT OF HIGH STRENGTH FILAMENTARY MATERIALS Quarterly Progress Report No. 2, 23 Jul. 1964–22 Oct. 1964
J. R. Bedell 15 Nov. 1964 21 p refs
(Contract NASw-927)
(NASA-CR-60550) OTS: HC $1.00/MF $0.50

Deposition runs of pyrolytic graphite upon molten platinum from methane at 7.0-mm pressure and 1970° C for 2 minutes duration produced a 0.0007-in. thick deposit. The wrinkled surface of the deposit was attributed to the liquid-to-solid contraction of the underlying platinum metal. Boron deposit runs on molten copper at temperature ranges from 1100° to 1300° C did not produce any deposits upon the melt surface, but silicon carbide runs at 1250° and 1300° C resulted in a weak film on the molten copper surface, and the heating element sprouted a zone of vitreous blue-black whiskers around its midsection. The introduction of methane at 8-mm pressure

to rhenium at 2000° C produced an extremely glossy deposit of a pyrolytic graphite structure with no adherence to the metal. The rhenium strip became extremely brittle as a result of the contact of the solid solution carbon with the metal surface, and thus demonstrated its unsuitability for repeated depositions of pyrolytic graphite. G.G.

N65-16271# Grumman Aircraft Engineering Corp., Bethpage, N.Y.
CONTOUR FORMING OF HONEYCOMB
Frank Greco 15 Jul. 1964 15 p
(ADN-08-18-64.1)

This investigation determines the methods and tooling required to develop an in-house capability to form flat fiberglass honeycomb core into the compound shapes required for radome manufacture. In the process of manufacturing several radomes, an in-house capability was developed with a minimum of equipment for forming core material presently used in the manufacture of doppler radomes; namely, NP 1/4-21-6.0 cut 0.192 ±0.003 (nylon phenolic core of 1/4-inch cell size with type 21 cloth and a density of 6.0 pounds per cubic foot). Each core shape is analyzed individually, and the procedures required depend on the variables encountered (such as type of honeycomb, size of cells, thickness of core, and severity of contour). The latter variables require some modifications in preparatory methods, but not in the basic tooling and forming concepts. Author

N65-16292# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRODYNAMIC DRIVE OF MECHANICAL VEHICLES PARTICULARLY AIRCRAFT AND COSMIC VEHICLES AND POWER PLANT ARRANGEMENT (PATENT NO. 43086)
S. Janiczek 7 Jan. 1965 4 p Transl. into ENGLISH from Tech. Lotnicza (Poland), no. 8, 1963 p 219-220
(FTD-TT-64-676/1+2; AD-455511)

An electrodynamic driving force is obtained by screening part of an electric circuit against the effect of magnetic fields, allowing the utilization of natural magnetic fields. The electric circuit consists of a current source and four arms which are placed in a homogeneous magnetic field. When three of the arms are magnetically shielded, an unbalanced force acts on the unshielded arm. The electric driving element consists of an inner conduit made of aluminum alloy with superconductivity properties at low temperatures, a magnetic screen made of material possessing adequate shielding properties at low temperatures, and an outer conduit of material having suitable low-temperature ferromagnetic properties and higher conductivity. The outer conduit is isolated from the screen with porous rings. Liquid helium maintains a very low temperature in the interior. The entire drive is enclosed in a housing made of a material with proper magnetic permeability qualities. R.L.K.

N65-16312*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF ADHESIVES FOR SEALING METALLIC AND PLASTIC FILMS FOR USE AT LIQUID-HYDROGEN TEMPERATURES
Paul T. Hacker, Francis J. De Vos, and Harley L. Stutesman (NASA. Manned Spacecraft Center, Houston) Washington, NASA, Feb. 1965 14 p refs
(NASA-TM-X-1057) OTS: HC $1.00/MF $0.50

An experimental investigation was conducted to evaluate the ability of 15 different adhesives to provide a hermetic seal in lap joints between thin metallic foils and plastic films in the presence of gaseous and liquid hydrogen. The lap joints were tested in a manner that provided a pressure difference of 20 pounds per square inch through the adhesive bond line but did not subject the joint to any mechanical stresses or loads. Each adhesive was tested at room, liquid-nitrogen (−320° F), and liquid-hydrogen (−423° F) temperatures. The adhesives tested are commercially available and included epoxy polyamines, nylon-filled epoxies, urethanes, polyesters, and rubber-based adhesives. In general, the most satisfactory adhesives system for sealing aluminum to aluminum, Mylar to Mylar, and Mylar to aluminum at cryogenic temperatures are the epoxies. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-15502# General Telephone and Electronics Labs., Inc., Bayside, N.Y.
CONFERENCE ON ORGANIC LASERS
25 May 1964 228 p refs Conf. held at Bayside, N.Y., 25 May 1964; sponsored jointly with ONR
(Proj. Defender)
(TR-64-052.6; AD-447468)

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3. RECENT RESULTS ON ENERGY TRANSFER IN RARE EARTH CHELATES M. Kleinerman (Am. Optical Co.) p 39-57 (See N65-15505 06-24)
4. EXCITONS AND TWO QUANTA PROCESSES IN MOLECULAR CRYSTALS R. M. Hochstrasser (Pennsylvania U.) p 58-71 refs (See N65-15506 06-26)
5. STIMULATED EMISSION IN ISOTOPICALLY MIXED BENZENE CRYSTALS D. S. Tinti and G. W. Robinson (Calif. Inst. of Tech.) p 72-90 (See N65-15507 06-26)
6. THE RARE EARTH CHELATE LASERS C. Brecker, H. Samelson, A. Lempicki, and V. A. Brophy p 91-109 refs (See N65-15508 06-16)

N65-15503 General Telephone and Electronics Labs., Inc., Bayside, N.Y.
THE ORGANIC LASER
A. Lempicki *In its* Conf. on Org. Lasers 25 May 1964 p 5-15 refs (See N65-15502 06-16)

The problems connected with the development of a purely organic laser are discussed. Pump requirements are compared for three types of laser systems; phosphorescent materials, such as benzophenone; existing ruby and chelate lasers; and fluorescent materials, such as anthracene and mixed crystals. R.L.K.

N65-15504 General Electric Co., Syracuse, N.Y. Electronics Lab.
STIMULATED EMISSION CONSIDERATIONS IN FLUORESCENT ORGANIC MOLECULES

David L. Stockman *In* Gen. Telephone and Electron. Labs. Conf. on Org. Lasers 25 May 1964 p 16–39 refs (See N65-15502 06-16)

The reasons for choosing fluorescent instead of phosphorescent compounds in developing an organic laser are discussed. Two promising molecules studied are perylene and 9-aminoacridine. The properties of liquid and polymeric resonant cavities formed with the organic host materials were investigated. Experimental results indicated that a pumped liquid resonant cavity at room temperature employing nonviscous liquids can be operated for about 30 μsec without increasing scattering losses to unbearable limits. For polymeric host materials, birefringence is being studied as a function of wavelength in the samples to determine the exact composition required to yield a zero stress optical coefficient at the wavelength of interest. Several approaches to the problem of generating sufficient peak power in a short time were made, the most promising pumping source being an argon theta-pinch lamp. The results of some pumping experiments are described. R.L.K.

N65-15508 General Telephone and Electronics Labs., Inc., Bayside, N.Y.
THE RARE EARTH CHELATE LASERS
C. Brecher, H. Samelson, A. Lempicki, and V. A. Brophy *In its* Conf. on Org. Lasers 25 May 1964 p 91–109 refs (See N65-15502 06-16)

The achievement of lasing in benzoylacetonate and dibenzoylmethide chelates of europium, and the problems of getting these materials to lase, are described. The DBM chelate, unlike the benzoylacetonate, does not lase in an alcohol solution, but the addition of small amounts of dimethylformamide to the solvent enables laser action to take place, showing the great effect of chemical changes on the characteristics of the emission. Chemical preparation methods for various materials can lead to 3-ligand and 4-ligand forms of chelates. The possible structures of the 4-ligand form are discussed. Other chemical problems reviewed include the extremely intense absorption of chelates. Where the absorption constant is too low, little energy can be absorbed; where the absorption constant is too high, little energy can reach the center of the cell to be absorbed. R.L.K.

N65-15570 Naval Ordnance Lab., Corona, Calif.
LASERS
R. L. Conger, J. H. Johnson, L. T. Long, and J. A. Parks *In its* Foundational Res. Proj. 1 Jun. 1963 p 41–45 (See N65-15565 06-34)

The observation by means of a phototube of the output of a ruby laser as a function of time is reported. A beam-width spread of 0.5° was reduced with a telescope to 0.07°, and it is suggested that this spread could be reduced to 0.02° with more refined apparatus and adjustments. A calorimetric determination of laser efficiency showed an efficiency of about 0.01%. This may be accounted for by xenon tube efficiency, low coupling between flash tube and ruby, nonradiative energy dissipation in the ruby, and nonradiative portions of the ruby. Pyrotechnics were investigated as possible pumping light sources, and it was concluded that pyrotechnic bombs are of no merit in laser experiments, because they produce less light than flash bulbs and have the disadvantages of noise and smoke. D.E.W.

N65-15605# Stanford U., Calif. Microwave Lab.
RESEARCH AND INVESTIGATION OF SELECTED MICROWAVE PROBLEMS Interim Engineering Report No. 6, 1 Jun–31 Aug. 1964
Oct. 1964 15 p refs
(Contract AF 33(657)-11042)
(ML-1243; AD-451327)

The following studies were made: (1) *Acoustic-Wave Interactions*—the current oscillations in a CdS single-crystal diode, the diffracting properties of ADP, and the diffraction of a pulsed ruby laser beam by sound modulation at 10 kc; (2) *Transverse-Wave Devices*—a periodic parallel-plate or twisted dc coupler to be used for the deflection of longitudinal velocity spread of electron beams; (3) *Optical Spectroscopy of Laser Materials*—the construction of an irradiator for the testing of solid materials for laser action in the ultraviolet and visible regions; and (4) *Nonlinear Quantum Studies*—the insertion of a KDP crystal modulator into a ruby laser cavity to generate a second harmonic mode. G.G.

N65-15753# New Mexico State U., University Park. Research Center
VARIATION OF REFRACTIVE INDEX DURING LASER OPERATION Semiannual Technical Report
J. R. Izatt, H. A. Daw, and R. C. Mitchell Jan. 1964 27 p refs
(Contract Nonr-3531(04))
(SATR-1; AD-427725)

Variation in refractive index as a function of the distribution of population among pertinent energy states can be studied experimentally by using a laser as a source with which to illuminate a sample of the same material. The latter is optically pumped to achieve a sequence of non-Boltzmann population distributions, and an interferometric technique is employed to determine refractive index as a function of frequency for each distribution. Temperature control or other means are used to scan the output of the source laser in frequency. A brief discussion of theoretical considerations is given as is a detailed description of the basic experimental techniques. Several items of equipment are described which were designed and constructed to partially fill the optical pumping and temperature control requirements of the experiment. A unique cast-plastic optical-pump cavity is described which has displayed high optical efficiency in addition to being durable and economical. Author

N65-15881# General Electric Co., Syracuse, N.Y. Heavy Military Electronics Dept.
SEMICONDUCTOR LASER AMPLIFIER TECHNIQUES (SEMLAM) Final Report
Griffiss AFB, N.Y., RADC, Oct. 1964 41 p refs
(Contract AF 30(602)-3111)
(RADC-TDR-64-384; AD-609704)

This report contains information on the work done in the semiconductor laser amplifier program. A transmission-type light amplifier was successfully tested. The system used consists of a light-emitting GaAs diode, with SiO antireflection coated Fabry–Perot surfaces, as an amplifier and a cw oxygen gas laser as an oscillator. A gain of 15 dB from the gas laser beam was observed. Author

N65-15980# Raytheon Co., Waltham, Mass. Research Div.
GASEOUS LASER RESEARCH Interim Engineering Report No. 2, Aug. 1–Oct. 31, 1964
F. Horrigan, S. Koozekanani, and R. Tataronis Wright-Patterson AFB, Ohio, Res. and Technol. Div. [1964] 48 p refs
(Contract AF 33(615)-1949)
(S-705; AD-608635)

Combining the results of the lifetime and cross-section considerations, a general explanation for the properties of a discharge-excited laser system were developed. This involves

nonselective excitation by the electrons followed by multiple cascading from the higher excited states into the lower sets of levels. To investigate the hypothesis in more detail, an extensive computer study of a simplified 40-level system is in the process of preparation, utilizing Bates–Damgaard lifetimes and reasonably constructed cross sections. A complete description of this program is given. No numerical results are as yet available. Difficulties with the electron beam focusing still remain the largest obstacle in the experimental program for the measurement of electron excitation cross sections in xenon. Several preliminary cross-section measurements are presented. It is concluded that multiple cascading must be playing an important role in xenon. Author

N65-16002# Air Force Cambridge Research Labs., Bedford, Mass. Optical Physics Lab.
APPLICATIONS OF LASERS
C. Martin Stickley Nov. 1964 43 p refs *Its* Spec. Rept. No. 15
(AFCRL-64-914; AD-609846)

This article is a survey of applications of lasers. The applications are divided into six major areas: precision measurements, communications, biological and medical, other scientific areas, metalworking, and miscellaneous. A table of the basic characteristics of the major types of lasers is provided, so that the user can be made aware of the limitations and capabilities of lasers. Good examples of applications in each of these areas are described in some detail to illustrate which major properties of laser radiation are useful in that particular area. Most of the discussion pertains to present-day applications, but in some instances what appear to be good future applications are also described. Seventy-two references to the technical literature that relate to applications are provided. Author

N65-16013# Electro-Optical Systems, Inc., Pasadena, Calif.
OPTICAL TRANSMITTER TECHNIQUES Technical Documentary Report, 15 Apr.–15 Jul. 1964
D. B. Bowen et al Griffiss AFB, N.Y., RADC, Dec. 1964 58 p refs *Its* Rept.-5180-Q-1
(Contract AF 30(602)-3440)
(RADC-TDR-64-442; AD-610106)

This report describes work directed toward the design and fabrication of a gas laser oscillator and a solid-state chelate laser operating at wavelengths ranging from 5.0μ to 0.3μ. New classes of sensitized fluorescence and their sensitizers were investigated, and system efficiency was improved through sensitizer purification. Some of the new sensitized systems investigated show promise of operation at or above room temperature. The scientific basis for sensitized fluorescence is clarified through a detailed analysis and description of the mechanism of energy transfer. Appropriate laser calculations and optimization were accomplished and associated laser test cavities, heat exchangers, and other equipment were built in preparation for testing the new materials. Author

N65-16017# Cutler-Hammer, Inc., Deer Park, N.Y. Airborne Instruments Lab.
STUDY OF SOLID-STATE AND TRAVELING-WAVE MASER TECHNIQUES Interim Report
J. A. De Gruyl, W. W. Heinz, S. Okwit, and J. G. Smith Griffiss AFB, N.Y. RADC, Jan. 1965 48 p refs
(Contract AF 30(602)-2989)
(RADC-TDR-64-480; AD-610317)

The purpose is to develop improved maser techniques and apply them to a broadband maser system. Magnetic shimming techniques capable of providing the proper field gradients in a superconducting solenoid were successfully tested. The analysis of broadbanding was extended to include the effects of nonideal magnetic field gradients and rf field distributions in the TWM structure. Correlation between theory and experiment is now much improved, facilitating the evaluation and application of these techniques to a deliverable breadboard. Limiting characteristics in a broadband stripline semiconductor limiter at 4.2° K were obtained. Techniques to decrease the limiting by using a more resonant, ridged waveguide structure are being developed. An analysis of a fine-wire superconducting limiter indicates that the operating bandwidth of such a device would be too narrow for the intended application. An analysis of the feasibility of superconducting thin-film tunneling techniques as a pump source for masers was completed and is presented. The obtainable power levels appear to be insufficient for maser pumping. Other solid–state techniques are being evaluated. Author

N65-16051# Navy Electronics Lab., San Diego, Calif.
A VERSATILE EIGHT-METER GAS LASER SYSTEM, DECEMBER 1962–MARCH 1964
V. N. Smiley and A. L. Lewis 28 Sep. 1964 21 p refs
(NEL-1242; AD-607969)

An 8-meter long, versatile gas laser and associated equipment were designed and constructed, employing three methods of excitation (60-cps ac, dc, and rf) and a Brewster-angle prism method of intracavity wavelength selection. The high gain resulting from the extreme length of the laser facilitated the finding of previously unreported laser lines in the infrared. A novel method of facilitating the alignment of mirrors, making use of the 3.39μ He-Ne line, was utilized. Calculations of reflectance for light polarized parallel to the plane of incidence for small deviations from the Brewster angle are given for an air-quartz interface. Author

N65-16056# California Inst. of Tech., Pasadena. Quantum Electronics Lab.
AN ANALYSIS OF PERTURBED CONFOCAL RESONATORS Scientific Report No. 3
J. F. Asmus Sep. 1964 141 p refs
(Contract AF 49(638)-1322)
(AFOSR-64-2074; AD-609769)

An analytical technique is developed for computing mode functions and associated diffraction losses of perturbed multimode optical resonators. It is based upon a consistent field formulation of resonance in an open two-mirror system. To illustrate the method, the theory of confocal resonators is extended to include configurations differing from the confocal case by small geometrical perturbations. This involves computing and expanding a perturbed Green's function for such near confocal resonators. Diffraction losses for certain statistical and deterministic perturbations are computed and related to disturbances arising from an imperfect figure, polish, or alignment of the mirrors. The design and construction of a stable laser spectrometer consisting of a single mode tuneable gas laser and a swept interferometer are described. Measurements of the diffraction losses of perturbed confocal resonators are found to be in agreement with the above analysis. Author

N65-16131# Sperry Gyroscope Co., Great Neck, N.Y. Electro-Optics Group
INVESTIGATION OF TECHNIQUES FOR ELECTROMAGNETIC ANGULAR ROTATION SENSING Interim Engineering Report No. 1, 1 Jul.–30 Sep. 1964

Wright-Patterson AFB, Ohio, Res. and Technol. Div., Oct. 1964 55 p refs
(Contract AF 33(615)-1931)
(AB-1272-0028-1; AD-608276) OTS: $3.00

A ring laser angular rotation sensor was designed for 100g centrifuge operation. Mode stabilization and control studies are aimed at improving the rotational sensitivity of the ring. Information on mode stability and number of simultaneously oscillating modes is investigated through the use of an analyzing Fabry–Perot cavity. Work on mode pulling and locking, including computer results, is included. The primary emphasis of the program is on designing, evaluating, and delivery ring laser systems for the Holloman 100g, 260-inch centrifuge. Considerations include thermal and mechanical stability. Author

N65-16252*# Wheeler Labs., Inc., Great Neck, N.Y.
DEVELOPMENT OF MACROSCOPIC WAVEGUIDE AND WAVEGUIDE COMPONENTS FOR OPTICAL SYSTEMS Final Report, Jan. 28–Nov. 28, 1964
E. R. Schineller, D. W. Wilmot, H. M. Heinemann, and H. W. Redlien 28 Nov. 1964 155 p *Its* Rept.-1247
(Contract NASw-888)
(NASA-CR-60527) OTS: HC $5.00/MF $1.00

In the development of single-mode, macroscopic optical waveguides and components, an all-dielectric waveguide, comprising a core and a cladding region of differing dielectric constants, was chosen for detailed study. Theoretical analysis of the waveguide medium resulted in the formulation of mode cutoff conditions, field distributions and propagation characteristics, and various methods for waveguide excitation were evaluated. Single-mode propagation was obtained from high optical quality fuzed quartz, ground and polished to size. Component study included theoretical design, performance analysis, and tests of waveguide configurations to determine the feasibility of all-solid components. Conclusions are: (1) Optical detectors fabricated in a single-mode waveguide are sensitive to the transverse distribution of both signal amplitude and phase. (2) Macroscopic optical waveguides and components are feasible. (3) The concept offers promises of high performance components for sophisticated laser systems. M.G.J.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-15523# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE INFLUENCE OF ULTRASOUND ON THE MECHANICAL PROPERTIES OF COPPER
I. V. Chernenko and V. S. Cherkashin 14 Nov. 1963 7 p Transl. into ENGLISH from Primenenie Ul'Traakustiki k Issled. Veshchestva (Moscow), no. 12, 1960 p 141–145
(FTD-MT-63-155; AD-605873)

Red copper, subjected to the influence of ultrasonic oscillations by 19.5-Kc frequency at temperatures of 600° to 700° in 15 to 20 min, changes from the plastic state into a brittle state. The increase of temperature and of scoring time causes a decrease of durability and plasticity during the simultaneous lowering of the microhardness. The electric resistance of copper is significantly increased during the increase of time and temperature scoring. The action of ultrasound on copper at increased temperatures results in the appearance of microcracks on grain boundaries, which culminates in the subsequent brittle destruction at room temperature. The scoring of copper at temperatures of 100° to 300° in 20 min causes lowering of its durability without lowering its plasticity. The scoring of the same duration at temperatures lower than 100° does not cause visible changes of properties and structure in copper. Author

N65-15551# IIT Research Inst., Chicago, Ill. Technology Center
VANADIUM ALLOY STUDIES Bimonthly Report, 1 Aug.–30 Sep. 1964
D. Weinstein and F. C. Holtz [1964] 9 p
(Contract NOw-64-0239-c)
(IITRI-B6021-4; AD-608237)

A vanadium alloy development program is being conducted for the purpose of producing improved short-time creep properties in the temperature range of 2200° to 2400° F. At present, the composition V-40Cb-30Ta-1Ti represents the material having the best creep properties without sacrificing fabricability or coatability; on the basis of creep strain over a 2-hr period at 2200° F, this composition is an order of magnitude better than any of the previously evaluated vanadium alloys. Work on the modification of this composition, using a variety of approaches to produce a stable, high-strength particle dispersion, is continuing. Author

N65-15578# Little (Arthur D.) Inc., Cambridge, Mass.
THE EFFECTS OF CASTING VARIABLES ON THE STRUCTURE AND PROPERTIES OF THIN-WALLED CASTINGS Final Report
Alwyn H. King Oct. 1964 33 p refs
(Contract DA-19-020-AMC-0250(A))
(C-65681; AD-451498)

This report describes a program of research directed toward an investigation of the effects of a number of casting variables (such as mold temperature, casting temperature, etc.) on the resulting microstructure and mechanical properties of thin-walled castings of light-metal alloys. Comparison of several aluminum alloys revealed very similar microstructures under similar casting conditions, in agreement with other investigators who found as-cast microstructure dependent primarily on solidification time, over a wide range of alloy compositions. The results of this study suggest that optimum mechanical properties may be attained in rapidly solidified castings by a relatively short solution treatment followed by appropriate aging, thus retaining the strengthening effect of a very fine microstructure, while still gaining the maximum possible influence of the solution hardening and aging phenomena. Author

N65-15591*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
VAPOR-DEPOSITED TUNGSTEN
6 Oct. 1964 28 p refs
(Contract NAS3-4165)
(NASA-CR-54266; GA-5640) OTS: HC $2.00/MF $0.50

Thermochemical reactions used in the vapor deposition of tungsten may be categorized as the pyrolysis of organometallic tungsten compounds, the thermochemical reduction of tungsten halides with a gaseous reducing

agent, or the pyrolysis of a tungsten halide. For the forming of free-standing structures, the most widely used process is the hydrogen reduction of WF_6. The properties of vapor-deposited tungsten are discussed, including purity, resistance to grain growth, preferred orientation, machining, and joining, as well as ductility, toughness, reliability, and strength. The fabrication of hardware items of complex shapes is also discussed. D.S.G.

N65-15641# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMAL TREATMENT AND PROPERTY OF ALLOYS Collection of Articles
D. Ya. Vishnyakov et al 2 Oct. 1964 187 p refs Transl. into English of the book "Termicheskaya Obrabotka i Svoystva Splavov" Moscow, Gos. Nauchno-Tekhn. Izd. Oborongiz, 1962 p 1–161
(FTD-MT-64-83; AD-608241) OTS: $5.00

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2. STRUCTURE AND PROPERTIES OF STEEL A40G D. Ya. Vishnyakov, N. P. Zhetvin, A. I. Paisov, and L. I. Krylova p 20–27 refs

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6. DETERMINATION OF OXYGEN CONTENT IN TITANIUM BY EQUILIBRIUM PRESSURE OF HYDROGEN INTRODUCED INTO IT V. A. Livanov, A. A. Bukhanova, and B. A. Kolachev p 99–107 refs

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10. INVESTIGATION OF PSEUDOBINARY SECTIONS OF TERNARY SYSTEMS BY METHOD OF EXTRACTION OF SOLID PHASE FROM MELT B. A. Kolachev p 137–146 refs

11. PECULIARITIES OF AGING OF ALLOY D16 K. S. Kirpichnikov and V. I. Kulakov p 147–159 refs

12. TWO-STAGE METHODS OF AGING OF ALLOY D16 K. S. Kirpichnikov and V. I. Kulakov p 160–168 refs

13. INFLUENCE OF CERTAIN TECHNOLOGICAL FACTORS ON SIZE OF MACROCRYSTALLINE FERRULE IN EXTRUDED PROFILES FROM ALLOYS D1 AND D16 K. S. Kirpichnikov, V. I. Kulakov, V. K. Zinov'yev, and S. N. Anan'in p 169–180 refs

N65-15643# Materials Research Lab., Inc., Richton Park, Ill.
THE USE OF STRAIN SOFTENING TO IMPROVE THE PROPERTIES OF REFRACTORY METALS Quarterly Progress Report, Jun. 1–Aug. 31, 1964
E. J. Ripling and S. Zager [1964] 10 p
(Contract NOw-64-0247-c)
(QPR-3; AD-608146) OTS: $1.00

Attempts were made to reduce the scatter in both as-received and flexed Mo-0.5 Ti by two different surface treatments, viz, electropolishing and mechanical grinding. Neither of these was effective in reducing the scatter, however, implying that scatter results from a random internal distribution of flaws. Surface notches were applied to the bend test samples to introduce a flaw larger than the random ones occurring in the plate. This decreased the amount of scatter, but, probably more important, the ductility at all testing temperatures was lowered so that a comparison of the flexed and as-received material was no longer limited by the angle of the punch. The introduction of the mild surface notch elevated the transition temperature 200° to 300° F. Flexing Mo-0.5 Ti plates was found to approximately double their notch bend ductility in both the longitudinal and transverse direction over much of the range of testing temperatures. Author

N65-15686# Joint Publications Research Service, Washington, D.C.
STUDIES IN HEAT ENGINEERING
R. Ye. Mazel et al 3 Feb. 1965 18 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 8, Aug. 1964 p 51–57
(JPRS-27820; TT-64-51931) OTS: $1.00

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2. THE EFFECT OF HEATING TIME ON THE STRUCTURE AND PROPERTIES OF Cr-Mn-Ni STEELS V. N. Gulyayev, V. Z. Tseytlin, L. I. Ryabova, N. P. Talov, and Yu. P. Bulanov p 10–16 refs

N65-15687# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
COMPUTER ANALYSIS OF THE HEAT FLOW IN THE VACUUM ARC MELTING OF MOLYBDENUM
Pierre du Manoir and Cyril M. Pierce Oct. 1964 17 p refs
(ML-TDR-64-308; AD-609651)

A Fortran computer program was created to analyze the transient heat-flow situation that results from arc melting of a 3 1/2-inch diameter molybdenum ingot in a water-cooled copper mold. The effects of several process variables on the time-variant ingot temperature distribution were then investigated. The numerical analysis indicated that a finer grain structure can be achieved when the power input is maximized, and that the use of maximum power and warm (200° to 400° C) coolants result in greater metal purification. Author

N65-15704# Aluminum Co. of America, New Kensington, Pa. Alcoa Research Labs.
DEVELOPMENT OF ALUMINUM-BASE ALLOYS Third Annual Progress Report, Sep. 29, 1963–Sep. 30, 1964
Allan P. Haarr 30 Oct. 1964 70 p refs
(Contract DA-36-034-ORD-3559 RD)
(Rept.-13-64-AP59-S; AD-451246)

The production and fabrication of high strength aluminum base alloys by powder-metallurgy techniques were highly successful. Hot-working techniques including compacting, extrusion, hot upsetting, impacting, forging, and/or rolling have

usually resulted in material that met ultrasonic inspection standards more critical than the requirements for aluminum alloy extrusions Class A inspection. Several alloys exceeded the strengths of 7178-T6 by 10%, having yield strengths of at least 96 000 psi and tensile strengths of at least 105 000 psi. One drawback was low ductility, although this does not exceed 5.0% for alloys 6, 19, and 71. The other high-strength compositions, alloys 20, 32, 34, 52, 62, and 64, have elongations below 5%. The quench sensitivity results in a specimen size effect. Several high-temperature alloys discussed have good cryogenic and elevated temperature properties from −112° to about 350° F. Above 350° F the tensile properties decrease quite rapidly. Notch sensitivity resulted in true burst strengths only in those alloys having the higher ductilities. Author

N65-15752# Horizons Incorporated, Cleveland, Ohio.
REINFORCEMENT OF NICKEL CHROMIUM ALLOYS WITH SAPPHIRE WHISKERS Final Report, 28 Oct. 1963–27 Oct. 1964
Richard W. Sicka, Theodore Harkulich, Mark S. Vukasovich, and Robert H. Kelsey 27 Oct. 1964 54 p refs
(Contract NOw-64-0125-c)
(AD-453303)

A program was conducted to secure a refractory metal–alumina single crystal fiber composite having high fiber loading (about 30 $^{v}/_{o}$) and exhibiting high strength reinforcement of iron or nichrome by inclusion of additives to the system prior to and during the fusion formation of the composite. Additives were presented as claddings on the fiber, as inclusions in the metal matrix, as special atmospheres during the melting of the metal phase and as oxide reactive additives serving as fluxing agents. Vacuum metallizing of the fibers prior to their inclusion in composite showed considerable promise for forming a homogeneous ingot by a method of hot pressing. Author

N65-15833# Naval Research Lab., Washington, D.C.
STEEL CORROSION MECHANISMS. THE GROWTH AND BREAKDOWN OF PROTECTIVE FILMS IN HIGH-TEMPERATURE AQUEOUS SYSTEMS: STUDIES WITH 15% NaOH AT 316° C
M. C. Bloom, G. N. Newport, and W. A. Fraser 17 Apr. 1964 13 p refs
(NRL-6082; AD-608334) OTS: $1.00

This report summarizes what is known regarding the reaction of steel with high-temperature water as affected by sodium hydroxide additions, and also presents results of a detailed study, using the hydrogen effusion method, of the reaction of steel with 15 percent sodium hydroxide solution at 316° C. The corrosion rates are correlated with a microscopic study of the growth and breakdown of the protective magnetite (Fe_3O_4) film. There are two different corrosion-rate-governing mechanisms involved prior to the onset of pitting: a large decrease of the initial corrosion controlled by the buildup of a protective film on the metal surface, and a subsequent smaller decrease in corrosion rate possibly controlled by penetration of the magnetite film by the corrosive solution. The pitting is apparently due to the genesis of cracks in the magnetite film after it reaches a critical thickness. Author

N65-15849# Brush Beryllium Co., Cleveland, Ohio.
DEVELOPMENT OF VERY HIGH STRENGTH BERYLLIUM WIRE Bimonthly Report No. 5, Aug. 6–Oct. 6, 1964
E. A. Murphy and R. G. O'Rourke 22 Oct. 1964 18 p refs
(Contract NOw-64-0162-c)
(TR-374-243; AD-608190) OTS: $1.00

The results of the work directed toward development of a process to produce high-strength beryllium fine wire are described. Material chemistry for the 5% and 2% copper–beryllium alloys is listed. The material of Group 3f, SOV-68, showed a definite increase in drawability over the other fine-grained materials. The evaluation of the SOV-68 hard-drawn wire that received its last anneal at 0.210-inch diameter showed a 15% increase in tensile strength, with a substantial increase in wire ductility at 0.00477-inch diameter size over any previously reported data. Author

N65-15853# Titanium Metals Corp. of America, New York, N.Y.
DEVELOPMENT OF A STABLE-BETA TITANIUM ALLOY Seventh Quarter Report, 1 Jan.–31 Mar. 1964
D. B. Hunter [1964] 27 p refs
(Contract DA-30-069-ORD-3743)
(WAL-TR-405/2-6; AD-608281) OTS: $2.00

Samples of Ti-17V-10Cr-3Al-1Si, quenched from 2050° F and aged at temperatures of 950° to 1150° F, showed Vickers' hardness increases ranging up to 100 points after aging for 1 hour or more at 1150° F. Lesser hardness increases were produced by aging at either 950° or 1050° F. Ti-17V-10Cr-3Al-0.5Si showed a similar, although smaller aging response. Such hardness increases were not accompanied by any clear microstructural change. Substitution of 0.2% Be for Si resulted in no aging response. Hypereutectoid alloys Ti-(8-10)Ni-5Fe, Ti-(8-10)Ni-5Mn, Ti-(11-13)Co-5Fe, and Ti-(11-13)Co-5Mn were quenched from 1750° and 1850° F and aged at 900° F. A marked aging response was found only in those alloys containing Ni. Metallographic examination showed that melting occurred in these alloys during solution treatment. Hot rolling pressure determinations on stable-beta alloys Ti-17V-10Mn-3Al and Ti-8Mo-8V-6Fe-3Al showed that these alloys were no more difficult to hot roll than the commercial beta alloy Ti-13V-11Cr-3Al. Complete substitution of Co for Fe in a stable-beta alloy Ti-8Mo-8V-5Fe-3Al did not improve uniform elongation. Partial substitution of Co for Fe in metastable Ti-17V-4Fe-3Al showed a slight improvement in ductility and brought about a faster aging response. Author

N65-15929# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. Materials Processing Dept.
RESEARCH ON REFRACTORY ALLOYS OF TUNGSTEN TANTALUM, MOLYBDENUM, AND COLUMBIUM Yearly Summary Report, Jul. 1, 1963–Jun. 30, 1964
Lawrence J. Stefan, Frank N. Lake, and Charles R. Cook Wright-Patterson AFB, Ohio. AF Mater. Lab., Sep. 1964 55 p refs
(Contract AF 33(657)-11239)
(ML-TDR-64-271; AD-451039)

Experimental efforts directed toward development of the 68%W-20%Ta-12%Mo solid solution strengthened high temperature alloy were successful. Efforts thus far have indicated that ingots of the alloy can be prepared by centrifugal casting techniques using uniquely designed molds, and can be extruded at ultrahigh temperatures to sound bar stock. Microstructures in both the as-cast and the extruded conditions are shown to consist of single phase, fine grains that appear ideal for further processing. The 1 hour-100% recrystallization temperature was determined to be 3300° F for the extruded stock. The 3000°, 3500°, and 4000° F tensile strengths determined from extruded stock after recrystallization are approximately three times those of unalloyed tungsten and are believed to be the highest reproducible tensile strengths of recrystallized material measured to date across this temperature range. Preliminary rolling studies have been conducted and are being continued toward the production and testing of sheet products of the alloy. Author

N65-15937# Springfield Armory, Mass.
SIMPLIFIED X-RAY ANALYSIS OF RETAINED AUSTENITE
H. R. Erard 2 Oct. 1964 50 p
(SA-TR20-2409; AD-451253)

An investigation was made to develop a series of charts to simplify the determination of volume percentage of retained austenite by X-ray techniques. The relative intensities of selected martensite and austenite diffraction lines were computed as functions of weight percentage of carbon. Charts were prepared from these data, displaying volume percentage of retained austenite as functions of weight percentage of carbon and the integrated intensity ratios between selected pairs of austenite and martensite diffraction lines. These charts apply only when the diffraction lines are obtained with the use of filtered chromium or cobalt X-radiations and an X-ray diffractometer. The X-ray determinations made with the use of these charts were substantiated by quantitative metallographic examination of specimens containing approximately 7, 20, and 50 percent austenite, respectively. Author

N65-15949*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESIDUAL STRENGTH OF ALLOYS POTENTIALLY USEFUL IN SUPERSONIC AIRCRAFT
I. E. Figge Washington, NASA, Feb. 1965 35 p refs
(NASA-TN-D-2613) OTS: HC $2.00/MF $0.50

Residual static-strength tests were conducted on sheet specimens 8 inches (20 cm) wide, containing central fatigue cracks of various lengths. Included in this investigation were several stainless-steel and aluminum alloys, one titanium alloy at two thicknesses, and one nickel-base alloy. Tests were conducted at −109° F (195° K), 80° F (300° K), and 250° F (394° K) for the aluminum alloys; the remaining alloys were tested at −109° F (195° K), 80° F (300° K) and 550° F (561° K). The 0.050-inch (1.27-mm) thick Ti-8Al-1Mo-1V (duplex annealed) demonstrated the most favorable overall residual static-strength to density ratios. Of the aluminum alloys, the clad RR-58 demonstrated the most favorable ratios. Analysis of the data by the use of the unified notch-strength analysis method is discussed. Included are some comments on the effect of heat treatment and thickness on residual static strength of Ti-8Al-1Mo-1V. Slow crack growth data are presented for several alloys. Author

N65-16026*# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
COLUMBIUM, TANTALUM, AND MOLYBDENUM Review of Recent Developments
E. S. Bartlett, F. F. Schmidt, and J. A. Houck 29 Jan. 1965 4 p refs

Tensile testing, stress-rupture testing, and bend testing are reported for alloys of the three metals. A report on heat treatment effects on such alloys was issued. Contaminating residual gases found during vacuum tests are listed, and techniques for reducing this contamination are suggested. Work on the pure metals and their various alloys is reported under a separate heading for each metal. D.E.W.

N65-16055# Manlabs, Inc., Cambridge, Mass.
MECHANICAL BEHAVIOR OF INTERMETALLIC COMPOUNDS Technical Documentary Report, 15 Sep. 1963–15 Sep. 1964
E. T. Peters, J. J. Ryan, I. Vilks, and L. E. Tanner 1 Dec. 1964 96 p refs
(Contract AF 33(657)-7432)
(ASD-TDR-62-1087, Pt. III; AD-609706)

The aging behavior of the intermetallic compounds VCo_3, VNi_3, and VNi_2 was investigated as a function of temperature, time, and composition. The disordered high-temperature structure of all compounds is fcc, and the ordered structures existing at lower temperatures are hexagonal, tetragonal, and orthorhombic, respectively. Room temperature microhardness measurements were obtained from stoichiometric specimens of the three compounds initially quenched from the disordered state to aging temperatures of 400°, 600°, and 800° C, and from several off-stoichiometric composition specimens of VCo_3 and VNi_3 aged at 600° C. In addition, electrical resistivity and hot hardness measurements were obtained as a function of temperature for the stoichiometric compositions. The structures developed in these specimens by aging were defined by light microscopy and X-ray diffraction analysis and, for VNi_3, by transmission electron microscopy. The observed hardness values obtained as a function of aging time are discussed in terms of crystallographic structure, transformation mechanism, microstructure, and the degree of long range order. Author

N65-16072# Joint Publications Research Service, Washington, D.C.
PRINCIPLES OF MAGNETOHEAT TREATMENT OF STEEL
Roman Skorski Huntsville, Ala., Army Missile Command, 22 Sep. 1964 37 p refs Transl. into ENGLISH from Prace Inst. Mech. Precyzyjnej (Poland), v. 9, no. 34, 1961 p 37–50
(RSIC-279; AD-607390)

Three problems were investigated and analysed to explain the phenomena occurring in iron and steel as the result of annealing in a magnetic field: (1) The electromotive force induced by a longitudinal magnetic field in a ferromagnetic wire submitted to torsional twist around its axis was studied, and the magnetostriction of iron (and steel) was found to be the resultant of the positive and the negative components. (2) The grain fineness in steel obtained by means of annealing in magnetic field is due apparently to increased surface tension which has been calculated on the basis of quantum mechanics considerations. (3) The formation of the tetragonal modification of martensite can be explained in terms of a hypothesis presupposing a disk-like shape of the iron atom. As a result of heat treatment in a magnetic field, an arrangement of the disc-like iron atoms occurs with main axis parallel to the induction flux. This leads to lattice oscillation in this direction and to an increase in lattice constants. The fact that at elevated temperatures the magnetostriction of iron always has a positive value is also due to this phenomenon. R.E.S.

N65-16110# Yale U., New Haven, Conn. Hammond Lab.
AN X-RAY DIFFRACTION STUDY ON THE EFFECT OF RHENIUM ON THE OCCURRENCE OF FAULTING IN REFRACTORY ALLOYS
E. N. Aqua and C. N. J. Wagner (Ph.D. Thesis) Sep. 1964 43 p refs
(Contract Nonr-609(43))
(TR-11; AD-608738)

The bcc alloys of the terminal solid solutions of rhenium in niobium, tantalum, and tungsten were investigated by several X-ray and metallographic techniques. Three different methods—the Fourier analysis, integral breadth determination, and the variance analysis—were utilized for the description of the X-ray diffraction powder pattern peaks. The anisotropic particle size broadening for the cold worked Ta-10a/o Re, W-20a/o Re and Nb-Re alloys (containing less than 11a/o Re) was interpreted as evidence for stacking and/or twin faults

on the (112) planes in the bcc structures. The addition of rhenium increased the fault density in the tungsten alloy, but not in the tantalum and niobium alloys. Author

N65-16118# Climax Molybdenum Co. of Michigan, Detroit. Research Lab.
STUDIES OF REFRACTORY ALLOY SHEET MATERIALS
Final Report, 15 Mar. 1963–15 Dec. 1964
Robert Q. Barr and M. Semchyshen 31 Dec. 1964 87 p refs
(Contract NOw-62-0419-c)
(AD-609815)

Pilot lots of 0.05-in.-thick sheet were rolled from ingots of the following compositions: (1) Mo + 1.59% Cb + 0.52% Ti + 0.21% Zr + 0.068% C, (2) Mo + 1.30% Ti + 0.35% Zr + 0.093% C, and (3) W + 3.10% Mo + 0.04% Zr + 0.001% C. The use of solution or solution and aging thermal treatments at the extruded billet stage (prior to rolling to sheet) markedly increased the recrystallization temperature and the elevated-temperature tensile and creep-rupture strengths of the two molybdenum-base alloys. Tensile strengths at 2400° and 3000° F as high as 84 500 and 24 600 psi, respectively, were recorded. Minimum recrystallization temperatures (100% recrystallization, 15 minutes at temperature) were in the 3100° to 3200° F range. The use of in-process thermal treatments tended to increase bend transition temperatures, although the degradation was more severe for strain-hardened than for fully recrystallized sheet. The small amount of excess phase present in the tungsten-base alloy precluded the use of carbide dispersion as a strengthening mechanism. Tensile strengths of 55 000 psi at 3000° F and 13 600 psi at 3500° F were observed for this material. The W-Mo-Zr alloy sheet exhibited higher strength to density ratios at 3000° F than any of the molybdenum-base alloys evaluated. Author

N65-16126# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Electromechanical Div.
A STUDY OF WELDS IN COLUMBIUM ALLOY D-43
J. M. Gerken 25 Mar. 1964 43 p refs
(TM-3865-67)

The welding characteristics of Du Pont D-43 (X-110) columbium alloy (nominal composition 10%W-1%Zr-0.1%C balance Cb) were investigated. Tungsten inert gas, electron beam and resistance spot welding methods were used. The wrought material was fully ductile to −320° F in the as-received, stress-relieved condition. The 45° bend transition temperature of this material was −140° F for tungsten inert gas welded specimens and −200° F for electron beam welded specimens. Application of an oxidation protective coating or addition of filler material caused an additional increase in the transition temperature above the as-welded condition. The D-43 welds showed a classical aging reaction when subjected to postweld heat treatment. Ductile spot welds were made in this alloy. Tensile strength of tungsten inert gas and electron beam welds in the as-welded condition was greater than the base material at 80° F and 2200° F testing temperatures. Author

N65-16139# Iowa State U. of Science and Tech., Ames.
ELECTRICAL RESISTIVITY AND PHASE BOUNDARIES FOR THORIUM-CARBON ALLOYS
Frederick William Korbitz, Jr. (Ph. D. Thesis) 1964 37 p refs
(AD-608348)

Revisions to the thorium–carbon system are proposed, based upon electrical resistivity measurements, metallographic examinations and X-ray data. The electrical resistivities of a series of thorium–carbon alloys were determined, and new values for the electrical resistivities of the two known carbides of thorium (ThC and ThC_2) are reported to be 115 ±15 microhm-cm and 15 ±2 microhm-cm at room temperature. Techniques for casting test bars of thorium–carbon alloys and for fabricating the alloys by carburizing small-diameter (1/16 in.) thorium wires have been developed and proven feasible. Electrical resistivity data plotted for a series of temperatures for compositions up to 9.4% carbon reflect a phase diagram construction corresponding to a series of solid solutions of ThC and ThC_2 with an intermediate phase of ThC characterized by brittleness, high hardness and high electrical resistivity. A sesquicarbide of thorium (Th_2C_3) at temperatures above 1200° C is suggested by the resistance "breaks" at 1240 ±10° C and other resistance "breaks" at high temperatures for compositions between ThC and ThC_2. Author

N65-16144# Iowa State U. of Science and Tech., Ames. Ames Lab.
THE EFFECT OF NITROGEN ON THE STRAIN AGING AND BRITTLE-DUCTILE TRANSITION OF VANADIUM
Robert W. Thompson and O. N. Carlson Aug. 1964 107 p refs
(Contract W-7405-ENG-82)
(IS-994) OTS: $4.00

The purposes were to determine the effect of nitrogen on the strain aging and brittle–ductile transition of iodide vanadium, and to determine the basic mechanisms responsible for the occurrence of these results. All of the mechanical effects generally associated with strain aging were observed. A study of the dynamic effects was characterized by the occurrence of a strain-aging peak and, from the activation energy determined from the strain-rate dependence of this peak, it was concluded that the diffusion of nitrogen with the moving dislocations was responsible for this peak. From a study of the return-of-yield point after straining and aging it was concluded that nitrogen was also responsible for the occurrence of the yield point observed in vanadium. Nitrogen does not embrittle vanadium when present in amounts below about 2000 ppm, while alloys containing greater than this amount of nitrogen exhibit a brittle-ductile transition temperature that increases with increasing nitrogen content. The transition temperature for single crystals is 50° to 60° C lower than that for the corresponding polycrystalline specimen. Carbon does not promote cleavage fracture in vanadium but when present as a carbide phase suppresses the occurrence of mechanical twinning. Author

N65-16160# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
SURFACE DAMAGE IN MACHINED BERYLLIUM
S. W. Porembka and H. D. Hanes 4 Jan 1965 14 p refs
(Contract AF 33(615)-1121)
(DMIC-MEMO-198)

It was observed that in machining beryllium, microcracking is associated with a mechanically twinned layer caused by the machining. The severity of microcracking appears to be associated with the depth of the machine cut made in a single pass. Actual quantitative data were generated from a study of a machining-damage problem associated with the shingles for the Gemini spacecraft. The influence of this surface damage on the mechanical properties of beryllium is important if the beryllium is employed as a structural material. The damaged surface can be removed by chemical milling, but it may be necessary to remove an appreciable amount of metal (several thousandths of an inch) to eliminate the deepest cracks. Such damage can be reduced by making light finishing cuts

Surface damage can be avoided if electrical-discharge machining or electrochemical milling can be employed to shape the part. Author

N65-16167# United States Steel Corp., Monroeville, Pa. Applied Research Lab.
FORMABILITY OF EXPERIMENTAL MARAGING STEELS Progress Report
K. E. Arnold and S. T. Rolfe 30 Sep. 1963 56 p refs
(Contract NObs-88540)
(AD-423809) OTS: $5.60

Because submarine-hull plates are presently cold formed to their final shape, a study was made to compare the forming characteristics of seven experimental maraging steels (yield strengths of 140 to 225 ksi) with those of the present HY-80 submarine-hull steel. The comparison was made by using 3/8-in. and 3-in.-wide by 3/8-in. thick bend-test specimens and standard tension-test specimens. The formability was judged on the basis of the amount of bending at onset of cracking and the true strain produced on the tension surface of the bend specimen. The results showed the 3/8-in. and 3-in.-wide specimens of HY-80 steel and 3/8-in.-wide specimens of maraging steels (with 2 exceptions for extremely brittle materials) could be bent flat (part angle of 0°) whereas the 3-in.-wide specimens of the maraging steels cracked at part angles greater than 135°. The results indicated that formability comparisons should be made on specimens wide enough so that bending occurs under conditions of plane strain. Author

N65-16208# Joint Publications Research Service, Washington, D.C.
POWDER METALLURGY OF SOME RARE AND RARE-EARTH METALS
12 Feb. 1965 32 p refs Transl. into ENGLISH of 3 articles from the book "Redkiye i Redkozemel'nyye Elementy v Tekhnike" Kiev, 1964
(JPRS-28739; TT-65-30320) OTS: $2.00

Yttrium, scandium, and lanthanum are discussed; and their electronic configurations, as well as the general characteristics of their compounds, are compared. Various carbides of the three elements were prepared, their properties are given, and synthetic methods are summarized. A solid solution of ScC-TiC was prepared whose microhardness was about 5000 dynes/m^2, considerably higher than that of TiC. The reaction kinetics of powdered titanium, zirconium, hafnium, vanadium, niobium, tantalum, chromium, and molybdenum were studied along with the reaction kinetics of hydrides of titanium and zirconium with nitrogen and ammonia. Laws were established under which these reactions proceed, and reaction rate constants were calculated along with the energy of activation of these processes. Production technology and some properties of sulfides and phosphides of several rare-earth and rare metals are briefly described. D.E.W.

N65-16241# California U., Berkeley. Metal Processing Lab.
VISIOPLASTICITY Progress Report, Sep. 30–Nov. 30, 1964
A. Shabaik, T. Altan, and E. G. Thomsen Nov. 1964 13 p
(Contract NOw-64-0070-d)
(PR-3; AD-609948)

Briefly described are two computer calculation methods used to process experimental data applying the visioplasticity method to the solution of forming problems. The finite difference method is being programed by FORTRAN for an IBM 7090 computer. The mathematical formulation of flow method appears more promising because strain rates and finite strains are more readily determinable. An attempt was made to compare potential flow with actual metal flow in plane strain. The object was to determine if the boundaries for potential flow can be adjusted in such a way that both the real and ideal flow fields are congruous. The results obtained to date indicate that potential flow may give a flow field closer to actual practice than do presently assumed theories. R.L.K.

N65-16242# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
CURRENT METHODS OF FRACTURE-TOUGHNESS TESTING OF HIGH-STRENGTH ALLOYS WITH EMPHASIS ON PLANE STRAIN
J. E. Campbell 31 Aug. 1964 28 p refs
(Contract AF 33(615)-1121)
(DMIC-207; AD-608701)

Fracture-toughness testing using principles of fracture mechanics has developed to the point where it can be used as a basis for selection of materials, for estimating limiting design stresses assuming the presence of small flaws, and for analyzing failures. Current methods of measuring plane-stress and plane-strain fracture-toughness parameters are presented in this report. The specimens described are center-cracked, edge-cracked, single-edge-cracked, or surface-cracked, and include notched round bars for tensile loading, and notched bars for bend tests. The different types of specimens permit evaluating sheet, plate, bar stock, and forgings as well as material from failed structures. Application of fracture-toughness parameters to design of high-strength structures is reviewed for both static and fatigue loading. Consideration of the fracture-mechanics concepts in design should lead to fewer problems with brittle fracture in high-strength structures. Author

N65-16256*# Battelle Memorial Inst., Columbus, Ohio.
IMPROVEMENT OF CREEP STRENGTH AND LOW-TEMPERATURE DUCTILITY OF REFRACTORY METALS BY MEANS OF MECHANICAL TWINNING First Quarterly Progress Report, 1 Sep.–30 Nov. 1964
J. W. Edington 30 Nov. 1964 14 p refs
(Contract NASr-100(05))
(NASA-CR-60540) OTS: HC $1.00/MF $0.50

Three metals were chosen for investigation: columbium, tungsten, and columbium–40 wt% vanadium alloy. The columbium alloy was chosen for an evaluation of the high-temperature strengthening mechanism. The columbium and tungsten were used to evaluate the possible improvement of ductility at low temperatures, because a comparison of the behavior of materials known to behave in a ductile and in a brittle manner was considered important. The columbium alloy was produced as a drop casting after melting columbium and vanadium in a nonconsumable-electrode electric-arc furnace. The columbium and tungsten were produced industrially in rod form. Each metal or constituent was originally commercially pure. The results are presented graphically and are discussed for high-temperature strengthening, for twin stability at high temperatures, and for ductility improvement at low temperatures. D.E.W.

N65-16287*# Battelle Memorial Inst., Columbus, Ohio.
INVESTIGATION OF MECHANICAL PROPERTIES OF CHROMIUM, CHROMIUM-RHENIUM, AND DERIVED ALLOYS Nineteenth Quarterly Progress Report
A. Gilbert 4 Jan. 1964 12 p
(Contract NASw-101)
(NASA-CR-60511) OTS: HC $1.00/MF $0.50

Experimental work is reported on the effect of rhenium on nitrogen precipitation in chromium, on the effect of rhenium on the strain-rate sensitivity of chromium at room temperature, and on the effect of rhenium on the slip planes in molybdenum. One project sought to determine whether rhenium additions of 3 to 5 at.% modified the grain-boundary precipitate morphology in such a way as to lead to enhanced ductility. No evidence was found for this effect, and further work on higher rhenium additions was pursued. D.E.W.

N65-16290# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATIONS OF THE NUCLEUS FORMATION IN METAL MELTS II (INFLUENCE OF SMALL AMOUNTS OF FOREIGN ELEMENT ADDITIVES ON THE SUPERCOOLING OF ANTIMONY MELTS)
W. Mannchen and H. Puttrich 15 Dec. 1964 38 p refs Transl. into ENGLISH from Z. Physik. Chem. (Frankfurt), v. 220, no. 5/6, 1962 p 355–378
(FTD-TT-64-431/1+2; AD-455489)

Subnuclei with lattice-like disorganized clusters are due to the polarization of the atoms of metal melts by foreign ions. Since a melt must be supercooled to the extent that the cluster is resistant to temperature variation, the supercooling temperature is related to the ion potential of the active foreign ions. To test this relationship, small amounts of carbon and silicon or germanium were added to antimony being melted in argon or hydrogen atmospheres. In some cases, ionization of the additive was promoted by a supplementary gamma radiation. Supercooling spectra showed a distribution in which discrete peaks appear at specific supercooling temperatures. In an argon atmosphere, 10 peaks between supercooling temperatures of 1.8° to 7.2° C were correlated with the polarization of the antimony atom by means of 10 possible ionization conditions of the carbon atom. They also appeared in melts with silicon and germanium additives, as a result of carbon impurities in these. R.L.K.

N65-16293# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CORROSION RESEARCH
4 Dec. 1964 73 p refs Transl. into ENGLISH from Korrozios Figyelo (Hungary), v. 3, no. 7, 1963 p 125–159
(FTD-TT-64-730/1+2+3+4; AD-455531)

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18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-15535*# Denver Research Inst., Colo. Technology Utilization Div.
NASA CONTRIBUTIONS TO THE TECHNOLOGY OF INORGANIC COATING
Jerry D. Plunkett, Washington, NASA, 1964 263 p refs Sponsored by NASA
(NASA-SP-5014) GPO: HC $1.00/MF $1.50

From a variety of sources, including NASA Research Centers and NASA contractors, technological contributions in the field of inorganic coatings are reviewed and their commercial implications are discussed. This report is subdivided into seven different areas of NASA interests: (1) thermophototropic coatings; (2) thermal control coatings for space vehicles; (3) solid lubrication coatings; (4) thermal insulation coatings; (5) methods of applying coatings to substrates; (6) measurement of coating optical properties; and (7) refractory metal oxidation resistant coatings. Also included is a bibliography of inorganic coatings and pigments. R.L.K.

N65-15547# Bureau of Reclamation, Denver, Colo. Chemical Engineering Branch
RESISTANCE TO CAVITATION DAMAGE, LABORATORY AND FIELD TESTS ON FOUR SELECTED COATINGS
30 Jun. 1964 40 p ref
(ChE-25; AD-450899)

Compared are the performances of the following four materials in laboratory and field tests: a liquid-applied neoprene rubber, a liquid-applied polysulfide rubber, a steel-filled epoxy, and a flexible epoxy. All of the field-applied materials showed damage after varying times of exposure. The damage in the field tests was more severe and rapid, and was not the same as the effects obtained in laboratory tests. The laboratory tests were conducted in a Venturi-type apparatus, and the field tests were conducted in the outlets at Grand Coulee Dam, Washington. Author

N65-15579# Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
EFFECT OF TEMPERATURE AND RATE OF LOADING ON THE TENSILE PROPERTIES OF GLASS-REINFORCED POLYESTER
Elise Mc Abee and Mitchel Chmura Oct. 1964 21 p refs
(PA-TR-3156; AD-451322)

The results of an investigation of the effects of rates of loading and temperatures on the mechanical properties of glass-reinforced polyester are presented. Standard tensile specimens were machined from sheets of glass-cloth-reinforced polyester in both the parallel and perpendicular directions. These specimens were subjected to tensile testing over a temperature range of −60° to + 80° C at both static and high

rates. At room temperature (23° C) and below, the stress–strain curves consisted of two straight portions connected by a knee. Above room temperature, a gradual curvature to failure was noted. With decrease in temperature and/or increase in rate, increases in strength, elongation, and work to produce failure were obtained. Author

N65-15663# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
INTERLAMINAR SHEAR OF FILAMENT-WOUND REINFORCED PLASTICS Quarterly Progress Report, 1 Jul.–4 Oct. 1964
Robert A. Elkin Oct. 1964 23 p refs
(Contract N60921-7094)
(QPR-4; AD-450340)

Described is a program to improve the interlaminar shear strength of filament-wound reinforced plastics. It was shown that the resin system was of prime importance for high-shear strength, but the improvements that could be made with new resin systems were limited. It was also found that a mechanical shear tie could be utilized to further improve the shear strength. This report contains the analytical work that was performed in an effort to optimize this shear tie or overwinding. The analysis will be utilized in the design and fabrication of several biaxial cylindrical specimens for compression testing. Author

N65-15786# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
SLIP-CAST FUSED SILICA
J. D. Walton and N. E. Poulos Wright-Patterson AFB, Ohio, AF Mater. Lab., Oct. 1964 142 p refs
(ML-TDR-64-195; AD-609667)

This workbook provides a collection of technical data and information on the slip-cast fused silica. It is intended to provide scientists and engineers with thermophysical, mechanical, electrical, and nuclear properties of slip-cast fused silica. Fabrication techniques and engineering data related to the use of this material for thermal protection systems and radomes are presented. A comprehensive bibliography is also included. Author

N65-15793# Brown U., Providence, R.I. Div. of Applied Mathematics
MULTIPLE INTEGRAL REPRESENTATION OF MECHANICAL BEHAVIOR OF POLYETHYLENE Technical Report No. 10
J. M. Lifshitz Dec. 1964 56 p refs
(Contract Nonr-562(30))
(Rept.-562(30)/10; AD-604657)

The response of viscoelastic solids to quasi-static loading, under conditions where nonlinear theories have to be used, was investigated. Creep measurements of tension and of torsion in polyethylene specimens are described. Step loading was used, and the deformations were measured optically by means of traveling microscopes for the tension experiments and by the reflection of light beams from mirrors for the torsion experiments. The deformations were too large for the theory of linear viscoelasticity to hold, and the constitutive relations used were of multiple integral form; some of the kernels involved were determined. It was found that for the loading range used, two kernels were sufficient for describing pure shear deformations and three kernels were required for tension. It was also shown that in this nonlinear region, the relation between shear stress and shear strain depended on whether or not dilatational stresses were present. Author

N65-15830# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
HOLLOW GLASS FIBER REINFORCED LAMINATES Final Report, 15 Jun. 1963–15 Aug. 1964
Z. Hashin et al [1964] 142 p refs
(Contract NOw-63-0674-c)
(AD-451684)

An evaluation test program was performed to: (1) compare the properties of hollow fiber composites with those of similar solid fiber composites; (2) compare theoretical and experimental results; and (3) provide initial property data for use in other evaluations. Material properties studied included thermal conductivity, which showed a lack of agreement between theoretical and experimental results; electrical properties showed that hollow fibers are better transmitters of electromagnetic energy; mechanical properties provided no verification of results; internal pressure tests for tensile strength produced lower than expected results; external hydrostatic pressure tests gave poor results; axial compression tests of filaments compared favorably with theoretical treatments; fatigue tests using the Prot–Wohler progressive stress technique showed that the hollow fiber composites have a higher endurance limit to density ratio. Hollow composites showed superior mechanical strength, mechanical rigidity, thermal insulation, and electrical transparency properties. R.E.S.

N65-15977# Rock Island Arsenal Lab., Ill.
ELASTOMERIC INSULATION FOR SOLID PROPELLANT ROCKET MOTORS
D. H. Sale 27 Oct. 1964 23 p refs
(Rept.-64-3158; AD-452948) OTS: $0.75

The development of flexible, elastomeric-based solid propellant rocket motor case insulation is discussed. The effects on insulation properties of the type of asbestos, of liquid versus solid elastomers, and of the methods of dispersing fibrous compounding ingredients, are reported. Oxyacetylene torch and static motor firing test data for some of the better insulation materials developed, as well as for some commercial materials, are presented. A material with 40% elongation, 1.34 gm/cc density, performance index of 95 cm^2sec/gm and erosion rate of 2.0 mils/sec was the most promising insulation developed. The material is a 55/45 butadiene–acrylonitrile compound containing phenol furfural resin, asbestos and oxyazoline wetting agent. It was satisfactorily bonded to aluminum and to steel by conventional bonding agent. The thermal properties of this vulcanizate are not affected by oven aging for 1 week at 70° C. Author

N65-16029# Rock Island Arsenal Lab., Ill.
IMPROVEMENT OF HIGH TEMPERATURE PROPERTIES OF A FLUOROELASTOMER, PART II
E. W. Bergstrom 13 Oct. 1964 15 p refs
(RIA-TR-64-3008; AD-452947) OTS: $0.50

This report covers results obtained in a study to improve the retention of physical properties of vinylidene fluoride/hexafluoropropylene (FPM) vulcanizates when measured at high temperatures. Several chemicals were evaluated as curatives for FPM, three being found effective. Calcium oxide was effective in eliminating the porosity associated with thick section post curing of FPM. Several phenolic and melamine resins were evaluated for improving the properties of FPM when measured at high temperatures. None proved effective. The use of carbon and graphite fibers in FPM was found to afford improved high temperature strength. The heat treatment of FPM and carbon black in the presence of N-methyl-N, 4-dinitrosoaniline improved the high

temperature properties of FPM. The use of high temperature press cures (400° F and above) did not improve the properties of FPM at high temperatures. Author

N65-16041# Watervliet Arsenal, N.Y. Benet R&E Labs.
α CLASSIFICATION OF MICROFIBERS, PART V
Michael A. Sadowsky and Moayyed A. Hussain Aug. 1964 25 p
(WVT-6417; AD-608679)

The δ-ring was put through the acceptance test with $\alpha = 4$, and a rigid fiber was formed in the result. The fiber $\alpha = 4$ passed the acceptance test and is available for use in analytic mechanics as a rigid fiber. Since all previous fibers with $\alpha = 1, 2, 3$ also passed the acceptance test, it seems that on similar future occasions reliance could be placed in the results of the simple tension test and simple bending test, without going through the general acceptance test. Author

N65-16107# Army Chemical Center, Edgewood, Md. Experimental Engineering Div.
SIXTEENTH MATERIALS REVIEW, JANUARY–JULY 1964
Arthur Lyem Oct. 1964 86 p refs
(CRDL-SP-5-6; AD-610534)

This review presents technical and scientific highlights regarding materials research here and abroad. Provided is information concerning recent technological advances, which are presented under five major headings: high polymers, plastic materials, synthetic fibers, miscellaneous organic and inorganic compounds, and metals and alloys. Over 300 articles were abstracted from various publications and languages. Materials and technological aspects are discussed, and a complete bibliography is given. Author

N65-16283# Boeing Co., Seattle, Wash. Aero-Space Div.
MACROLAMINATE PARTICLE COMPOSITE MATERIAL DEVELOPMENT Bimonthly Progress Report, Aug. 1–Oct. 1, 1964
F. H. Simpson and L. M. Stejskal [1964] 25 p
(Contract NOw-64-0194-f)
(IR-3; AD-451714)

Development of the knife-coating process for producing laminate sheets of alternate metal and ceramic layers has shown that shrinkage of the wet layers varies greatly with thickness in a nonlinear manner. Due to the compensation of swelling for drying shrinkage, best control can be obtained producing layers 0.0013-in. thick, but it should be possible to produce single layers of 0.0007 to 0.0013 in. with adequate control. Laminate particles from which the organic binder has been removed can be isostatically pressed at pressures from 20 to 40 ksi. Nine vacuum sintering cycles for a statistically planned experiment to evaluate the effect of temperature, time at temperature, heating rate, and cooling rate have been completed. Average flexural strength values for the composites varied from 39 to 58 ksi for the various sintering cycles used. A yield point in the load deformation curves prior to failure of the flexural specimens was observed for specimens fired under six of the nine conditions. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-15451# Army Research Office, Durham, N.C.
PROCEEDINGS OF THE NINTH CONFERENCE ON THE DESIGN OF EXPERIMENTS IN ARMY RESEARCH, DEVELOPMENT AND TESTING.
Dec. 1964 597 p refs Conf. held at Army Missile Command, Redstone Arsenal, Ala., 23–25 Oct. 1963; Sponsored by Army Math. Steering Comm.
(AROD-64-2; AD-450443)

Experiment Design and Statistical Methods in Reliability Estimation, Information Theory, Rocket Engine Development, Weapon Evaluation, and Missile Trajectory Determinations. For individual titles see N65-15452–N65-15479; and N64-19392.

N65-15452 George Washington U., Washington, D.C.
COMMUNICATION THEORY
Solomon Kullback *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 1–15 (See N65-15451 06-19)

Concepts of interest to the communication engineer, i.e., facets of information theory, are discussed. A system, or information source, ϕ, is considered which has c different possible events with probabilities of occurrence $p_1, p_2, \ldots, p_c$ The expression

$$H(\phi) = -p_1 \log p_1 - p_2 \log p_2 - \ldots - p_c \log p_c = E(h),$$

where h is a random variable which takes on the value of $\log 1/p$ for each event, is called the entropy of the system ϕ. The entropy is interpreted as the mean uncertainty about ϕ prior to an observation, or the mean information about ϕ provided by the observation. The properties of $H(\phi)$ are presented. The closely related coding theorem is discussed, which states that given a source of mean information of H bits per observation, it is possible to encode or translate sequences of observations into sequences of two elements only. Applications of these concepts are presented. D.S.G.

N65-15453 Boeing Scientific Research Labs., Seattle, Wash.
THE CONCEPT OF MONOTONE FAILURE RATE IN RELIABILITY THEORY
Frank Proschan *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 17–71 refs (See N65-15451 06-19)

It is shown that in the analysis of reliability problems, an error in the original assumption of the underlying failure distribution may be greatly compounded at the final conclusion. A reliability analysis based on a conditional failure rate, i.e., increasing failure rate (IFR) which might correspond to wear-out, or a decreasing failure rate (DFR) which might correspond to work hardening, is discussed. The bounds on the quantities of interest are determined for IFR and DFR distributions, and a number of reliability models are presented that illustrate how the assumption of IFR(DFR) distributions simplifies the solutions. Operations under which a monotone failure rate is preserved are also discussed. D.S.G.

N65-15459 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
COMPUTER SIMULATION STUDY OF BRUCETON AND PROBIT METHODS OF SENSITIVITY TESTING
John B. Gayle *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 205–227 refs (See N65-15451 06-19)

A computer simulation technique was used to evaluate the suitability of the Bruceton and Probit methods of sensitivity testing for launch vehicle applications. The results indicated that either method permits satisfactory estimates for the mean value of a normal distribution. However, for launch vehicle applications, estimates of the levels of stimulus corresponding to very high or very low percentage reactions usually are required; and neither method permits reliable estimates for such levels when the distribution is nonnormal, a condition which occurs with sufficient frequency that assumption of a normal distribution cannot be justified as routine procedure. Author

N65-15466 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

MONTE CARLO APPLICATION FOR DEVELOPING A DESIGN RELIABILITY GOAL COMPATIBLE WITH SMALL SAMPLE REQUIREMENTS

Ray Heathcock and Dale L. Burrows *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 319–357 refs (See N65-15451 06-19)

This report describes the application of Monte Carlo simulation to the construction of empirical sampling distribution of reliability estimates obtained by sampling from the classical stress and strength (load and failure) distributions, which are assumed gaussian. Typical stress–strength distributions, representing specific values of reliability, were stored in a computer. From the distributions, various sample sizes were taken and the resulting estimate of reliability computed. Iteration of this process resulted in the construction of empirical sampling distributions for specific values of reliability and specific sample sizes. Emphasis was placed on very high values of reliability and on very small sample sizes. Since the sampling distribution of reliability estimates was found very sensitive to the ratio of the standard deviations of the stress and strength distributions, sampling distributions were constructed for specific values of this ratio. The true ratio of standard deviations will seldom be known, therefore the variation in the sampling distribution due to this ratio introduces a certain weakness into the application of the analysis. This weakness is discussed fully. Author

N65-15467 National Institutes of Health, Bethesda, Md. Div. of Biologics Standards

EXACT CONTINGENCY TABLE CALCULATIONS

Dorothy Berg, Morley Leyton, and Clifford J. Maloney *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 359–382 refs (See N65-15451 06-19)

The past development of approximations to exact contingency probabilities is reviewed. A table of population samples versus the numbers of those treated and those infected in a vaccine trial led to a rule for calculating exact probabilities in a 2 × 2 contingency table. The general formula for the probability of a specified 2 × n contingency table with fixed marginal totals is given, and the general R × C table is discussed in terms of a 3 × 3 table. A method of calculating these probabilities is devised, in which the various tables are calculated in the order of decreasing probability, and a running sum of the probabilities of all tables calculated so far is maintained. A criterion is set, for example, at 0.99999, and the calculation is terminated when this total is reached. The procedure for the formation of the set of adjustment matrices in the order of decreasing probability is discussed, and tables are included illustrating the technique. D.E.W.

N65-15468 Sandia Corp., Albuquerque, N. Mex.

FACTORIAL EXPERIMENTS WITH THE FACTORS APPLIED SEQUENTIALLY

R. R. Prairie and W. J. Zimmer *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 395–420 (See N65-15451 06-19)

In the application of factorial experiments in industry, it is often necessary to apply the factors sequentially. For 2^P experiments in which (1) multiple testing on each experimental unit is possible and not degrading, (2) the effects of the factors are permanent, and (3) the low level of a factor is the absence of that factor, a design and an analysis are presented which allow the estimation and testing of order effects as well as the usual main and interaction effects of the factors. Author

N65-15469 Johns Hopkins U., Baltimore, Md. Pan American World Airways, Inc., Patrick AFB, Fla.

ESTIMATION OF ERROR SPECTRA FROM THE CROSS-AUTOCOVARIANCE FUNCTIONS OF DIFFERENCES

D. B. Duncan and W. T. Wells (Pan Am. World Airways) *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 421–468 refs (See N65-15451 06-19)

A problem is considered of estimating the error or noise spectra of several tracking systems, all of which are simultaneously observing the same trajectory or signal. Previous work on processes of one dimension is extended here to processes of several dimensions. Estimates are obtained under the requirement that they be independent of the trajectory, and through differences between the processes rather than through their average processes. Tables of error spectral density are presented. D.E.W.

N65-15472 Wisconsin U., Madison. Mathematics Research Center

STATISTICAL DECISION THEORY

Lionel Weiss *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 541–545 (See N65-15451 06-19)

Statistical decision theory is applied to the following type of problem: $X_1,...X_m$, $Y_1,...Y_n$ are jointly distributed random variables, whose joint distribution is not completely known, but is known to be one of a given set of possible joint distributions. After observing $X_1,...X_m$, but before observing $Y_1,...Y_n$, a decision must be made. After the decision is made, $Y_1,...Y_n$ are observed, and a loss is incurred that depends on the decision chosen and on the observed values of the random variables themselves. The problem is to determine the way in which to base the decision on the observed values of $X_1,...X_m$. Ways of formulating decision rules are discussed, and some basic principles are stated. D.E.W.

N65-15474 Army Missile Command, Huntsville, Ala.

AN ANALYSIS OF FACTORIAL EXPERIMENTAL DESIGNS

L. W. Kesting *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 569–604 refs (See N65-15451 06-19)

A simple technique involving the analysis of variance is proposed for the initial evaluation of data obtained from a factorial experimental design. The application is presented for a general two-factor rectangle that could result from any factorial design. Equations were developed that permit the use of a uniform, simplified worksheet. An experimental design using the technique is proposed for studying the effects of heat on the insulation

barriers separating auxiliary rockets from other missile components. A factorial design is suggested with four factors at levels 4, 3, 3, and 2, confounded in the multiple interactions. The type, thickness, and positions of insulation materials and the type of structural material supporting the insulation are considered. More test information and greater precision for less test time and equipment are the advantages of factorial designs of the type suggested. A numerical example illustrates the application of the analysis of the variance technique at marginal conditions of significance. Author

N65-15475 Aberdeen Proving Ground, Md. Ballistic Research Labs.
RELIABILITY ESTIMATION FOR MULTI-COMPONENT SYSTEMS
J. R. Kniss *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 605–621 (See N65-15451 06-19)

A highly flexible, fast, and simple procedure for estimating reliability is described. The data for the estimation procedure are taken from tests of the reliability of individual components of a system, such as a nuclear warhead system. With the reported estimation procedure, a point estimate of reliability and a confidence interval about that estimate can be obtained for almost any system. The estimation procedure enables a computer to construct an interval in a few minutes. D.E.W.

N65-15478 Texas A&M U., College Station. Inst. of Statistics
SOME SMALL SAMPLE THEORY FOR NONLINEAR REGRESSION ESTIMATION
H. O. Hartley *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 655–660 refs (See N65-15451 06-19)

A nonlinear regression model is given, and a theorem on the sufficiency of a certain equality for the existence of a set of p statistics that are jointly sufficient for a certain set of p parameter functions is presented and proved. D.E.W.

N65-15479 Johns Hopkins U., Baltimore, Md.
ON THE SIMULTANEOUS ESTIMATION OF A MISSILE TRAJECTORY AND ERROR COMPONENTS INCLUDING THE ERROR POWER SPECTRA OF SEVERAL TRACKING SYSTEMS
David B. Duncan *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 661–681 refs (See N65-15451 06-19)

The designing of a computer program by the development of a linear mixed model and the development of models with stationary processes is discussed. Basic ideas currently used in reductions of trajectory data in programs included under the names of "best estimate of trajectory" and "Glotrac" are considered, and similar ideas are extended to include the additional presence and estimation of stationary autocorrelated errors in the tracking observations and in the trajectory itself. D.E.W.

N65-15644# RAND Corp., Santa Monica, Calif.
WENGERT'S NUMERICAL METHOD FOR PARTIAL DERIVATIVES, ORBIT DETERMINATION, AND QUASILINEARIZATION
R. Bellman, H. Kagiwada, and R. Kalaba Nov. 1964 12 p refs
(Contract AF 49(638)-700)
(RM-4354-PR; AD-608287) OTS: $1.00

The method of quasi-linearization for the numerical solution of nonlinear multipoint boundary-value problems is discussed. Applications to system identification, cardiology and design and control are given. The determination of orbits is discussed. The method involves the calculation of many partial derivatives which can be quite onerous and the source of errors. A procedure was suggested by R. Wengert for the calculation of partial derivatives that relieves the analyst and the programer of much routine differentiation. The purpose of this report is to show the usefulness of the Wengert scheme in carrying out the quasi-linearization procedure. The orbit determination problem is discussed. Author

N65-15713# Kansas U., Lawrence.
INTERPOLATION SPACES AND INTERPOLATION METHODS
N. Aronszajn and E. Gagliardo Jan. 1964 92 p refs
(Contract Nonr-583(13); Grant NSF GP-439)
(TR-3; AD-430756)

The historical development of interpolation methods between Banach spaces is outlined, and the general structure of all possible methods was studied by determining all of them and analyzing the properties that are common to all. Basic material is collected to give a precise and intrinsic definition of the notion of "compatible Banach Spaces". Interpolation spaces are considered in detail, and the main results concerning interpolation methods and interpolation theorems are discussed. D.E.W.

N65-15717# RAND Corp., Santa Monica, Calif.
SOME ASPECTS OF THE RELATIONSHIP OF DYNAMIC PROGRAMMING TO THE CALCULUS OF VARIATIONS
Stuart E. Dreyfus Nov. 1964 16 p refs
(P-3008; AD-608366) OTS: $1.00

This report introduces dynamic programing and considers the relationship between dynamic programing and the other techniques of control theory. Also discussed is the problem of rigorizing the dynamic programing approach to variational problems. An example is used to demonstrate how dynamic programing, when applied in a formal fashion, yields simple and intuitive derivations of rather complicated results. Dynamic programing is used to develop a second-order transversality condition for a problem with a variable initial point. Author

N65-15757# California U., Berkeley.
ALMOST PERIODIC SURFACES
John Glen Marica Jan. 1964 33 p refs
(Contract Nonr-222(88))
(AD-434210)

The existence of an almost periodic surface, (in fact a more general surface), is equivalent to the existence of a fixed point for a certain transformation defined on the space of parameterizing functions. Exhibition of conditions under which the transformation has a fixed point is made. The methods and results are similar to those of Hale, and Bogoliubov and Mitropolski, the essential difference being that in Hale's basic theorem the coefficient of the linear term is a constant matrix, while in these results the corresponding matrix is diagonal. Author

N65-15760# North Carolina State Coll., Raleigh. School of Physical Sciences and Applied Mathematics
THE USE OF TRANSFORM METHODS IN ELASTICITY
Ian N. Sneddon 6 Nov. 1964 198 p refs
(Grant AF-AFOSR-444-64)
(AFOSR-64-1789; AD-453791)

The Fourier and Hankel integral transforms are applied to the solution of boundary problems in elastostatics. The equations of elastic equilibrium and their solution are reviewed. Plane strain problems are considered, using only the theory of Fourier transforms. The Hankel transform is used in some three-dimensional problems. Two special classes of spatial problems are considered, the calculation of thermal stresses, and the solution of certain simple forms of the contact problem. Some unfamiliar properties of Fourier and Hankel transforms are collected in an appendix. R.L.K.

N65-15783# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Applied Mathematics Research Labs.
SIMULTANEOUS TESTS FOR TREND AND SERIAL CORRELATIONS FOR GAUSSIAN MARKOV RESIDUALS
P. R. Krishnaiah and V. K. Murphy (Douglas Aircraft Co.) Oct. 1964 19 p refs
(ARL-64-186; AD-609654)

In this report, exact tests are proposed for testing the trend in the presence of autocorrelation and also for testing the trend and autocorrelation simultaneously in a first-order Markov process. Also, the simultaneous confidence intervals associated with these tests are derived. These results are extended to h-th-order Markov process. Author

N65-15797# Hamburg U. (W. Germany).
PROGRESS IN THE MATHEMATICAL THEORY OF NON-COMMUTATIVE LATTICES (SKEW LATTICES) Final Report No. II
Pascual Jordan 1964 67 p
(Contract AF 61(052)-567)
(ARL-65-23; AD-455082)

The following topics are considered: *Semi Groups of Idempotents*—the basic concepts and definitions, the general semigroups of idempotents (denoted by H), normal H, flat ordered H, and direct products of ordered H; *About Distributive Skew Lattices*—new proof of an old theorem, the concept of skew lattices, modular and distributive axioms, and flat doubly distributive uncurled skew lattices; and *Matrix Representations of Semigroups of Idempotents*—an example involving the Lazerson representation of semigroups of idempotents, semigroup rings, and triangular matrices. G.G.

N65-15831# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AN INEQUALITY FOR CERTAIN CORRELATION FUNCTIONS Group Report 1964-63
R. T. Prosser 29 Oct. 1964 9 p ref
(Contract AF 19(628)-500)
(AD-608288) OTS: $1.00

A study of the properties of varactor diodes has recently led to the following problem whose solution is presented. Let q(t) be a continuous function, periodic with period 2π. It is known that the autocorrelation function R(t) associated with q(t), as defined by

$$R(t) = \int_0^{2\pi} q(t-t')\,q(t')\,dt',$$

has the property that it achieves its maximum at the origin:

$$R(t) \leq R(0).$$

Now suppose U(x) and V(x) are continuous monotone increasing functions, defined at least on the range of q(t). The modified correlation function S(t) is defined by

$$S(t) = \int_0^{2\pi} U(q(t-t'))\,V(q(t'))\,dt'$$

The question, does S(t) achieve its maximum at the origin, is considered, and an affirmative answer is shown. Author

N65-15836# National Bureau of Standards, Washington, D.C. Statistical Engineering Lab.
MISCELLANEOUS STUDIES IN PROBABILITY AND STATISTICS: DISTRIBUTION THEORY, SMALL-SAMPLE PROBLEMS, AND OCCASIONAL TABLES
Churchill Eisenhart et al 24 Apr. 1964 20 p refs
(NBS-TN-238) GPO: $0.20

Included are the following: (1) *Distribution of the Ratio of Two F Variates Having n-1 and n Degrees of Freedom;* (2) *Some Notes on the Cauchy Distribution*—includes variance of the sample mean for the truncated Cauchy distribution, and the Cauchy distribution whose cumulative distribution function deviates least from the standard normal c.d.f.; (3) *The Better One out of Two*—variance of the observation closet to the population mean; (4) *Variance of Medians and Pseudo-medians*—for sample sizes m up to 10, gives the variances (5D) of the median (m odd), pseudo-median (m even), and the average of two values on either side of the median (m odd), for the normal and rectangular distributions, and ($m \geq 6$) for the extreme-value distribution; and (5) *Probability Points of Order Statistics in Random Samples of Size n from a Uniform Distribution over (0,1).* Author

N65-15869# RAND Corp., Santa Monica, Calif.
ON COMMUTING FUNCTIONS
Jon H. Folkman Nov. 1964 19 p refs
(Contract AF 49(638)-700)
(RM-4342-PR; AD-608060) OTS: $1.00

There is a rather well-known conjecture that if f and g are continuous functions from [0,1] to [0,1] which commute (i.e., $f(g(x)) = g(f(x))$), then f and g have a common fixed point. The conjecture is known to be true in some special cases; e.g., when f and g are polynomials. H. Cohen has proved the conjecture for the case when f and g have a property he calls fullness. Cohen's theorem is used when f is full and g is arbitrary. This result is especially interesting because a special form for only one of the functions is assumed. Author

N65-15893# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
TABULATION OF LEGENDRE FUNCTIONS AND CONICAL FUNCTIONS
Edward W. Ross, Jr. Oct. 1964 203 p refs
(AMRA-TR-64-24; AD-454611)

This report presents tabulations of several different classes of Legendre functions. First, the functions $P_\nu(\cos\theta)$ and $Q_\nu(\cos\theta)$ for real, fractional ν and real θ are given in the range $-0.5 \leq \nu \leq 3.5$, $0 \leq \theta < 180°$ at intervals $\Delta\nu = 0.02$, $\Delta\theta = 2°$. The tabular values are given to six decimal places with a possible error of one in the sixth digit. Second, the conical functions, $P_{-1/2+ib}(\cos\theta)$, and their derivatives $dP_{-1/2+ib}(\cos\theta)/d\theta$ for real b and θ are given in the range $0 \leq b \leq 5$, $0 \leq \theta < 180°$ at the somewhat coarser mesh, $\Delta b = 0.1$, $\Delta\theta = 5°$. These tabular values are given only to five significant figures with a percentage absolute error that should not exceed one in the fifth figure. Author

N65-15905# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON SIMULATING CERTAIN RECENT MATHEMATICAL PROBLEMS
V. I. Ivanenko 30 Oct. 1964 16 p refs Transl. into ENGLISH from Tr. Vses. Konf.-Seminar po Teor. i Metodam Mat. Modelirovaniya 2D (Moscow), 1962 p 21–29
(FTD-MT-64-264; AD-608181)

The ways of using computers to simulate certain mathematical problems are discussed. One class of variational problems in automatic control is considered; the method of modeling in a machine complex is discussed; certain peculiarities in combining a dc analog computer with a general-purpose digital computer of parallel action are enumerated, and two examples are given. D.E.W.

N65-15972# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
A PROGRAM FOR THE SOLUTION OF A CLASS OF GEOMETRIC-ANALOGY INTELLIGENCE-TEST QUESTIONS
Thomas G. Evans Nov. 1964 100 p refs *Its* Phys. and Math. Sci. Res. Papers No. 64
(AFCRL-64-884; AD-609845)

A program was constructed for solving a wide variety of intelligence-test problems of the geometric-analog type: "Figure A is to Figure B as Figure C is to which of the following figures?" The program, written in the LISP language,[6] uses heuristic methods to calculate, from relatively primitive representations of the input figures, descriptions of these figures in terms of subfigures and relations among them. It then utilizes these descriptions to find an appropriate rule and to apply it, modified as necessary, to arrive at an answer. The organization of the program in terms of figure descriptions, which are analyzed to find transformation rules, and of rule descriptions, which are analyzed to find common generalizations of pairs of transformation rules, has implications for the design of problem-solving programs and for machine learning. These implications are discussed, and suggestions are made for work on pattern-recognition and learning techniques. Author

N65-15992# Aeronautical Research Associates of Princeton, Inc., N.J.
ON OPTIMAL CONTROL WITH BOUNDED STATE VARIABLES Final Report
Bernard Paiewonsky Jul. 1964 49 p refs
(Contract Nonr-3703(00))
(ARAP-60; AD-607911)

This report surveys the present status of the bounded state space problem in optimal control theory. Two different methods are used to formulate the variational problem, with each method providing a set of different but equivalent necessary conditions. The physical meaning of these conditions is examined along with their use in computational procedures. It is shown that the solution to the bounded state space problem requires the solution of a system of differential equations in which auxiliary conditions are specified not only at the initial and terminal points, but at each intermediate point at which the optimal trajectory enters or leaves the boundary surface. Author

N65-15993# Wisconsin U., Madison. Mathematics Research Center
ON THE CONVERGENCE OF FORMAL SOLUTIONS OF SYSTEMS OF LINEAR ORDINARY DIFFERENTIAL EQUATIONS CONTAINING A PARAMETER Technical Summary Report
Yasutaka Sibuya Sep. 1964 12 p
(Contract DA-11-022-ORD-2059)
(MRC-511; AD-607825)

This is a study of systems of linear nonhomogeneous differential equations of the form

$$(E) \qquad \epsilon^{\sigma} \frac{dy}{dx} = A(x, \epsilon)\, y + f(x, \epsilon),$$

where x is a complex variable, ϵ is a complex parameter, σ is a nonnegative integer, y is an n-dimensional vector, A and f are respectively an n by n matrix and an n-dimensional vector whose components are holomorphic functions of (x, ϵ) in a domain $x \in D \mid \epsilon \mid \leq r_0$. The D is a simply connected compact domain in the x-plane and r_0 is a positive constant. Two problems were studied: the convergence of a formal solution $y = \sum_{k=0}^{\infty} \epsilon^k p_k(x)$ of the system (E) when this formal solution converges at a point of D; and (2) the structure of the system (E) which has holomorphic solutions for $x \in D$ and $\mid \epsilon \mid \leq r_0$. Author

N65-16034# American Science and Engineering, Inc., Cambridge, Mass.
TABLES OF ABSCISSAE AND WEIGHTS FOR THE EVALUATION OF INTEGRALS OF THE FORM $\int_0^{\infty} x^a e^{-x} f(x)dx$ Final Report, Part I
Yvain M. Treve 1 Jul. 1964 36 p refs
(Contract AF 19(628)-2388)
(ASE-511; AFCRL-64-594(i); AD-609940)

The abscissae and weights of the Gauss–Laguerre quadrature formula

$$\int_0^{\infty} x^a e^{-x} f(x)\, dx \sim \sum_{k=1}^{n} W_{k,n}^{(a)} f\left(x_{k,n}^{(a)}\right)$$

are given to 18 places for a = 3, 4, 5, 9/2, 11/2 and 13/2 and n = 1 (1) 16. Author

N65-16078*# Martin Co., Baltimore, Md. RIAS Div.
CONTROL, STABILITY AND NONLINEAR OSCILLATIONS Final Report, 24 Aug. 1963–24 Aug. 1964
J. P. La Salle and R. E. Kalman Sep. 1964 40 p refs
(Contract NASw-845)
(NASA-CR-60480) OTS: HC $2.00/MF $0.50

Major progress was made in extending the knowledge of ordinary differential equations to functional differential equations (equations with time delays). Efforts were also concentrated on stochastic optimization problems. Additional progress is reported, both in the realm of stochastic optimal control and stochastic optimal filtering. The problems were properly formulated, and it became clear where further research is required. The theory of automata was a second area of concentration. This may be regarded as the algebraic part of control theory, in contrast to the preceding, more analytical, investigations. D.E.W.

N65-16134# Maryland U., College Park.
FUNDAMENTAL RESEARCH IN APPLIED MATHEMATICS Final Report, 1 Jul. 1962–30 Jun. 1964
M. H. Martin Jul. 1964 8 p refs
(Grant DA-ARO(D)-31-124-G134)
(AROD-407-67; AD-608224)

The research projects described were centered principally on problems involving partial differential equations. The construction of nonlinear boundary problems was considered for nonlinear partial differential equations, for which the solution is unique, either unconditionally or under prescribed conditions.

Applications of the general theory were found in fluid dynamics and differential geometry. Also considered were partial differential equations for which a Huyghen's principle holds; this was done in an attempt to settle the conjecture that the only one for which the principle holds is the wave equation in n independent variables where n is even. Reported are work on elliptic difference operators and Dirichlet's problem, and studies concerning the stability and accuracy of methods of numerical integration of fluid motion equations over long periods. D.S.G.

N65-16155# Texas U., Austin. Linguistics Research Center
EXPERIMENTS WITH A NEW CLASSIFICATION ALGORITHM
David Senechalle Dec. 1964 31 p refs
(Grant NsF GN-308)
(LRC-64-WTM-6)

Experiments leading to the development of a new algorithm for automatic classification are described, and some of the mathematical properties of the problem and the algorithm are investigated. The algorithm locates subsets, termed D-clumps, in an object space consisting of a symmetric connection matrix formed from initial binary object-property incidence data. The D-clumps satisfy criteria of internal cohesion, and of differentiation from their respective complements, that make them useful entities in automatic classification procedures. Author

N65-16222# Aberdeen Proving Ground, Md. Ballistics Research Labs.
THE CUBIC SPLINE: A CURVE FITTING PROCEDURE
P. R. Schlegel Jul. 1964 22 p refs
(BRL-1253; AD-451085)

The cubic spline is an interpolating procedure that has given good numerical approximations to the derivative of the function being interpolated. This interpolating procedure uses piecewise cubic polynomials with its first and second derivatives continuous at the junction points. Author

N65-16255*# Emory U., Atlanta, Ga.
A SERIES USEFUL IN THE STUDY OF DIFFERENCE EQUATIONS
Tomlinson Fort Dec. 1964 17 p refs
(Grant NsG-545)
(NASA-CR-60536) OTS: HC $1.00/MF $0.50

This paper is concerned with series of the type

$$\sum_{n=1}^{\infty} C_n [(z + h_1(z))(z + h_2(z)) \ldots (z + h_n(z))]^{-1}$$

where $z = x + yi$, with x and y real. In addition it is required that $0 < \epsilon \leq h_n(z) \leq E(n)$, that $h_n(z) \to \infty$ when $n \to \infty$ and that $x + h_n(z)$ increase with x. Eight convergence theorems are given and proved, as are two uniqueness theorems. New conditions are set, in which the independent variable is real, and denoted by x. Then two step-up and two step-down theorems are stated and proved, and a multiplication theorem is given and proved. D.E.W.

N65-16273# Office of Research Analyses, Holloman AFB, N. Mex. Mathematics Div.
APPLICATION OF CONTOUR INTEGRALS TO PROBABILITY PROBLEMS
Herbert Knothe Oct. 1964 21 p ref
(ORA-64-3; AD-454749)

In this paper it is shown that the application of contour integrals in the Gaussian plane is very advantageous in various probability problems. Four detection problems are formulated in which n observers search an area A for s objects, randomly distributed in A. The areas A covered by the single observers are equal and do not overlap. Let p be the probability that an object is detected by an observer. The problems considered are the following: (1) What is the probability that each of exactly ρ observers detect at least one object? (2) What is the probability that each of the n observers detect at least ρ objects? (3) In problem (2) it is supposed that $na = A$; in this problem, it is supposed that $na \leq A$. Then, what is the probability that each searcher detects at least ρ objects? (4) This problem is a slight modification of problem (3). What is the probability that each hunter (searcher) kills at least ρ animals (objects), where p_k is the probability that a detected animal is killed and the same for each hunter? Author

N65-16280# Office of Research Analyses, Holloman AFB, N. Mex. Mathematics Div.
CONTOUR INTEGRAL SOLUTION TO OCCUPANCY PROBLEMS
Richard H. Anderson Oct. 1964 13 p refs
(ORA-64-2; AD-454739)

A contour integral in the Gaussian plane is developed to express the number of distributions of ρ distinguishable elements into σ cells such that each cell is occupied by at least μ elements. This representation is valuable in the solution of many occupancy problems of probability theory, and an example is given to illustrate the utility of the contour integral representation. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-15426# Joint Research Publications Service, Washington, D.C.
CLOUD MODIFICATION
Nikolay Sergeyevich Shishkin 25 Jan. 1965 40 p refs Transl. into ENGLISH of Chapter 10 of the book "Oblaka, Osadki i Grozovoye Elektrichestvo" Leningrad, 1964 p 286–317
(JPRS-28438; TT-65-30193) OTS: $2.00

Developments in cloud modification over the past 20 years, which were reported in numerous published articles, are reviewed: *Physical Principles of Cloud Modification, Methods of Cloud Modification, Scattering of Supercooled Clouds, Artificial Inducement of Precipitation, and Prevention of Hail and Dangerous Showers.* Examples of successful cloud modifications are discussed. D.E.W.

N65-15522# Wisconsin U., Madison.
AN ANALYSIS OF DIURNAL VARIATIONS IN TIROS RADIATION DATA. THE ROLE OF SYNOPTIC SCALE VARIATIONS OF INFRARED RADIATION IN THE GENERATION OF AVAILABLE POTENTIAL ENERGY Annual Report
Elford G. Astling, Lyle H. Horn, and James L. Corcoran Oct. 1964 52 p refs
(Grant WBG-10)

Twenty-six days of TIROS II data are used to study diurnal variations of infrared radiation (7μ to 32μ). A diurnal

trend is noted. When the data are partitioned into land and ocean data, diurnal variations are found in both cases. A diurnal trend in the land cases was expected; however, the trend over oceanic areas was not anticipated. An analysis of sampling procedures used in the study indicates that the oceanic trend is not the result of a sampling bias. The possible causes for this trend include a number of instrument calibration problems and a number of physical processes occurring within the earth–atmosphere system. Because a number of possible causes exists, diurnal variations in TIROS II infrared observations should be interpreted with caution. Author

N65-15524# Denver U., Colo.
PROBLEMS IN EXPRESSION OF CLIMATE Technical Paper No. 64–3
Robert D. Rudd Feb. 1964 20 p refs
(Contract DA-31-124-ARO(D)-79)
(AD-450592)

The two levels of climate expression provided are the characterization of elements individually, and their characterization collectively. Individual expressions should be representative to check the degree of resemblance between days, to check against monthly summarized data, and to consider problems of expression; they should include: (1) weekly maximum 24-hour precipitation; (2) average precipitation per rainy day; (3) frequency of occurrence of rainy days per week; (4) frequency of occurrence of selected categories of daily amount per week; and (5) average and maximum weekly precipitation totals. The utility of summarized data expressed in a temporal framework of less than a month was established. Total climate and climate types need standardized parameters that collectively express foreseeably needed aspects of the climate at a given location. A logical numerical code-expression study is needed for data processing. Climate classification needs balance between sufficient detail, several climate types, and adequate generalization. R.E.S.

N65-15581# Secretariat General a l'Aviation Civile, Paris (France).
FREQUENCY OF CERTAIN METEOROLOGICAL CONDITIONS UNFAVORABLE FOR AIR SERVICE AT 37 AIRPORTS [FREQUENCES DE CERTAINES CONDITIONS METEOROLOGIQUES DEFAVORABLES POUR L'AERONAUTIQUE A 37 AERODROMES]
A. Tasson, R. Bubeck, and P. Charli Jul. 1964 151 p In FRENCH Its Monographies de la Météorol. Natl. No. 32

A tabulated review is presented of foggy conditions with parameters of height and extent of area calculated both by the mean of all days observed and by the percentage frequencies of all synoptic observations. It is concluded that heavy foggy flying conditions are rarer in the Mediterranean region than in any other region of France. Particularly good conditions are found around Saint-Raphael, Nice, Ajaccio, and Bastia. The very heavy morning fog of other areas is not found at all at Nice; however, fogs do appear in the afternoons in this area. For annual variation, the worst conditions are found between October and January from 4 to 6 a.m. in southern France and from 6 to 7 a.m. in northern France. November to January produce the heaviest fogs of around 9 a.m. in northern France. R.E.S.

N65-15582# Secrétariat General a l'Aviation Civile, Paris (France).
SOME ASPECTS OF TROPICAL STORMS AND CYCLONES IN THE PACIFIC SOUTHWEST [QUELQUES ASPECTS DES DEPRESSIONS ET CYCLONES TROPICAUX DANS LE PACIFIQUE SUD-OUEST]
J. Giovannelli and J. Robert Aug. 1964 28 p refs In FRENCH Its Monographies de la Météorol. Natl. No. 33

A review of theories of origin and movement of tropical depressions and cyclones, established by J. F. Gabites in Tokyo, in 1962, is presented. The study includes 100 storms over a period of 15 years. A depression has winds between 33 and 63 knots per hour, while a cyclone has winds greater than 63 knots per hour. Of the storms, 27% were cyclonic. Storms usually begin around 10° latitude and occur between the Coral Sea and the Cook Islands. Storms occur at the end of the hot season and at a time when temperatures of the air and the surface of sea show greatest the difference, and usually travel in an easterly direction. The change of direction and the period of origin of the storm produce the slowest movement while in the areas of greatest curvature of shape, and during periods of straight direction the fastest movement occurs. R.E.S.

N65-15583# Secretariat General a l'Aviation Civile, Paris (France).
RESULTS OF SEVEN YEARS OF EXACT MEASUREMENT OF WIND AT AN ALTITUDE UP TO 30-40 Km IN THE PARIS REGION [RESULTATS DE SEPT ANNEES DE MESURE PRECISE DU VENT EN ALTITUDE JUSQU'A 30–40 Km DANS LA REGION PARISIENNE]
G. Barbé, J. Ballay, P. Ervet, and A. Robuchon Oct. 1964 182 p refs In FRENCH Its Monographies de la Météorol. Natl. No. 34

Graphic tabulated results of wind measurements are presented, along with the representation of wind directions and tabulated statistics of directions and velocities. Radar, reflectors, balloons, and automatic calculators were used for measurements and statistics. The precision of the measurements is given in the bibliography. R.E.S.

N65-15584# Secretariat General a l'Aviation Civile, Paris (France).
STUDY OF THE RATE OF VARIANCE OF DAILY LEVELS OF PRECIPITATION MEASURED AT PARIS-MONTSOURIS DURING 90 YEARS, 1873–1962 [ETUDE DE LA FREQUENCE DES DIFFERENTES HAUTERS JOURNALIERES DES PRECIPITATIONS MESUREES A PARIS-MONTSOURIS AU COURS DES 90 ANNEES 1873–1962]
H. Grisollet Oct. 1964 13 p ref In FRENCH Its Monographies de la Météorol. Natl. No. 36

This study omitted days with no precipitation. The lowest rate of daily precipitation considered in tabulations was 0.1 mm. Tabulations of both mean and median results were made to show the monthly and annual characteristics of days with precipitation. January showed the least number of days with precipitation, while October showed the most. However, the annual mean resolved to a greater figure than the mean of the month of January. A tabulation of the annual variation for the number of days with precipitation used the least figure of 0.1 mm and the greatest figure of 10.0 mm. The greatest number of days by this method occurred between May and October. Also, in a study of distribution of frequency of the levels of precipitation during a mean year, Eggenberger and Polya presented a new theory of "contagion of probability" R.E.S.

N65-15585# Secretariat General a l'Aviation Civile, Paris (France).
CONSIDERATIONS OF HYDROLOGICAL BALANCE. 1: RIVER BASINS OF AVERAGE IMPORTANCE. 2: MEDITERRANEAN TORRENTS [CONSIDERATIONS SUR LE BILAN HYDROLOGIQUE. 1: BASSINS FLUVIAUX DE MOYENNE IMPORTANCE. 2: TORRENTS MEDITERRANEENS]

P. Fontaine, A. Orieux, F. Guin, E. Pouget, A. Barbia et al Oct. 1964 40 p refs *In* FRENCH *Its* Monographies de la Météorol. Natl. No. 37

Two methods of study of total solar retention are: (1) the measurement of agricultural reserve, a quotient between total rainfall and plant transpiration; and (2) the measurement of hydrological reserve, a quotient between rainfall and level of underground springs. Following experiments using the established normal values, the two reserves were computed, and the results agreed favorably with those of Thornthwaite and Mather. It was concluded from experiments on transpiration and hydrological balance in the areas of Mediterranean torrents that: (1) An hydrological balance quotient could be established by estimating the amount of flooding after the drought and the total deposits expected. (2) The Thornthwaite relationship equation was verified. (3) Prediction can be made for the extent of the drought and the estimation of the water flow quotient at the flood peak. R.E.S.

N65-15586# Freie U., Berlin (W. Germany). Institut für Meteorologie und Geophysik

EXAMINATION OF 24 HOUR PROGNOSTIC SURFACE CHARTS Final Technical Report, 1 Aug. 1963–31 Jul. 1964

[1964] 45 p refs

(Contract DA-91-591-EUC-2944)

(AD-451536)

The 24-hour prognostic surface charts of the British and German weather services (of 0600 GMT) and of the British and U.S.S.R. weather services (of 0000 GMT) were studied and compared for a period of several months. The investigation was concerned with the locations of central pressures and the positions of cyclones and anticyclones. Actually occurred and prognosticated changes were compared and characterized by a quality number system. The results of the investigation are presented in tabular form. Also discussed is a special investigation dealing with characteristic cases of misprognoses. P.V.E.

N65-15835# Hawaii Inst. of Geophysics, Honolulu.

MONTHLY MEAN RESULTANT WINDS AT 50 MILLIBARS OVER THE PACIFIC 1956–1960, PART I Final Report

Carl W. Adams 15 Aug. 1964 69 p refs

(Contract N123(61756)32495A(PMR))

(HIG-64-14; AD-451527)

This report presents the monthly mean wind field analyses of the 50-millibar constant pressure surface for the period of January 1956 to December 1960, inclusive. The 50-millibar pressure surface is located in the stratosphere at a mean elevation of about 68 000 ft (20 750 meters) over the subtropical and tropical Pacific Ocean area. Author

N65-15886# Oklahoma U. Research Inst., Norman. Atmospheric Research Lab.

DIURNAL AND SEMIDIURNAL VARIATIONS OF ISOPYCNIC SURFACES UP TO THE MESOPAUSE AS INFERRED BY THE WIND FIELD Scientific Report No. 4

David Eugene Pitts Oct. 1964 61 p refs

(Contract AF 19(628)-489)

(ARL-1357-4; AFCRL-64-650; AD-609723)

Slopes of surface of constant air density were determined from wind data gathered primarily by the meteorological rocket network. These slopes are depicted as a function of altitude, latitude, season, and time of day. Where data permit, they are extended to 90-kilometers altitude. The results agree well with the known features of the density field and suggest additional characteristics of density behavior. Author

N65-15955*# RAND Corp., Santa Monica, Calif.

DETERMINATION OF THUNDERSTORM DENSITY BY RADIO OBSERVATIONS FROM A SATELLITE

R. L. Kirkwood Jan. 1965 28 p refs

(Contract NASr-21(07))

(NASA-CR-60422; RM-4417-NASA) OTS: HC $2.00/MF $0.50

This report presents a theoretical consideration of the radio frequencies that might be used to estimate the density of thunderstorms from an artificial satellite. The ways that electromagnetic radiation from lightning strokes is propagated through the ionosphere are examined, and a comparison of signal-to-noise ratios at the satellite's receiver is made for the various usable frequencies. It is found that, above 400 Mc, signal power from a lightning stroke will usually be inadequate, but that at about 300 Mc, with antenna gain of about 10, the signal will probably satisfactorily exceed the noise. In the 6- to 20-Mc range the signal will be well above the noise, and a directional antenna will not be needed because the ionosphere itself can be used to restrict the field of view. At much lower frequencies whistlers are detectable by a satellite receiver, but the location of the source lightning stroke would be ambiguous, and the size of the antenna needed to resolve this ambiguity would be prohibitive. Author

N65-16022# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

BALLISTIC WIND VARIABILITY AT GREEN RIVER, UTAH

Manuel Armendariz Jan. 1965 31 p refs

(ERDA-251; AD-455553)

Meteorological data gathered during June, July, and August 1963, at Green River, Utah, are statistically treated and ballistically applied to the Athena B-3 missile. Wind variation over 10-minute time increments indicates a one-sigma impact dispersion of approximately 15 miles for the north–south component and 25 miles for the east–west component. Author

N65-16039# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

METEOROLOGICAL ROCKET NETWORK FIRINGS, VOLUME XII-B; SUMMER 1962 FIRINGS Data Report

Dec. 1964 339 p

(IRIG-109-62, Vol. XII-B; AD-454881)

Meteorological rocket firings between July 15, 1962, and August 31, 1962, are reported. All launchings that yielded good data are included; the launchings took place from Cape Canaveral, Eglin Air Force Base, Kauai, Kindley Air Force Base (Bermuda), McMurdo Sound (Antarctica), Point Mugu, Tonopah Range (Nevada), Wallops Island, and White Sands Missile Range. Data reported include altitude profiles of wind speed, wind direction, and temperature. D.E.W.

N65-16099# RAND Corp., Santa Monica, Calif.

COMPLETE SCATTERING PARAMETERS OF POLYDISPERSED HYDROMETEORS IN THE λ 0.1 TO λ 10 cm RANGE

D. Deirmendjian Nov. 1964 23 p refs Submitted for Publication

(P-2914-1; AD-608409)

The extinction, the albedo of single scattering, the differential scattering cross section, and the complete polarization properties, per unit volume of cloud and rain elements, irradiated by microwave radiation at various frequencies were determined. Continuous drop-sized distribution functions are introduced

to represent real clouds and precipitation, and the absorption and scattering parameters are integrated with high accuracy. A Rayleigh approximation is found adequate for the cloud model, but the complete Mie expressions had to be used for precipitation-sized particles. Older estimates were corroborated, but some new features have been brought out for the first time, such as the scattering intensity and polarization (including its ellipticity) as a function of scattering angle. Author

N65-16157 Travelers Research Center, Inc., Hartford, Conn.
WEATHER DATA PROCESSING RESEARCH AND DEVELOPMENT PROGRAM Monthly Progress Report, Oct. 1964
Glyndon L. Lynde et al Oct. 1964 8 p
(Contract Cwb-10704)
(AD-608101)

Described is the work performed in the major areas of weather prediction, meteorological data processing, the analyses of terminal weather variations, and statistical technique engineering. G.G.

N65-16191# Air Weather Service, Lowry AFB, Colo. 24th Weather Squadron
TERMINAL FORECAST REFERENCE FILE
Fern L. S. Steepleton and Curtis L. Hartzell Jul. 1964 111 p refs
(AD-451071)

This file includes information to serve as a basis of weather forecasting in the Denver-Lowry Air Force Base area. Descriptions are given of the location and topography, factors influencing local weather, air pollution, location of stations and instruments, terrain cross section, weather controls for seasons and major synoptic features. The general climate is discussed, and local forecast studies are presented with detailed descriptions of synoptic types of condtions, specific conditions of clouds, visibilities, precipitation, and methods. A series of empirical rules for forecasting in the area is presented. R.E.S.

N65-16204# Joint Publications Research Service, Washington, D.C.
ON THE SOLUTION OF A SYSTEM OF EQUATIONS FOR SHORT-RANGE WEATHER FORECASTING
G. I. Marchuk, G. P. Kurbatkin, Ye. Ye. Kalenkovich, V. I. Panchuk, G. S. Rivin et al 9 Feb. 1965 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geofiz. (Moscow), no. 12, 1964 p 1849–1858
(JPRS-28671; TT-65-30292) OTS: $1.00

A complete system of equations of hydrodynamics of the atmospheric processes is considered. An algorithm is given for calculating the fields of the geopotential and the wind velocity vector. The solution of a complete system of equations for weather forecasting is presented in an adiabatic approximation, allowing for the quasi-steady-state of the motion on a flat earth. A 10-level model of a baroclinic atmosphere is considered, based on the use of central differences with respect to all geometric variables. Programs were constructed for computers, and a number of numerical experiments were performed with respect to forecasting the weather one day ahead. An analysis of the results showed that the method had adequate accuracy in predicting the future pressure field. D.E.W.

N65-16228# Travelers Research Center, Inc., Hartford, Conn.
A STATISTICAL APPROACH TO 2–7-hr PREDICTION OF CEILING AND VISIBILITY, VOLUME II
Sep. 1964 204 p
(Contract Cwb-10704)
(TR-2; AD-451124)

The sets of possible predictors and station networks for each of the 36 predictands in the statistical forecasting method for regression estimation of event probabilites are presented. The 36 sets of selected predictors for the 36 predictands are listed, and some restrictions on choosing the large sets of possible predictors are described. Mathematical proof is presented that the probabilites of a REEP forecast sum to one. G.G.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-16331# Federal Aviation Agency, Atlantic City, N.J. Experimentation Div.
EXPERIMENTATION WITH REGAL VERTICAL GUIDANCE LANDING SYSTEM Final Report
V. Bencivenga and E. J. Murphy Nov. 1964 117 p refs
(RD-64-149)

Static and dynamic tests were conducted on REGAL (Range and Elevation Guidance for Approach and Landing), a vertically scanned microwave guidance system, to determine its suitability for use in an all-weather landing system. Areas of investigation included low-angle coverage, position determining accuracy, siting effects, noise content, scan rate, scan direction, method of signal coding, type of antenna pattern, weather effects, interference susceptibility, and optimum flight path characteristics. Aircraft using REGAL guidance information, coupled to various approach and flare couplers, were flown to touchdown using both manual and automatic control. Flight tests were conducted in a C-54G, Aerocommander, JC-131B and B-25 aircraft in both clear and adverse weather including rain, snow and fog with wind conditions varying from direct head winds to tail wind components of 20 to 25 knots. More than 200 automatic landings were accomplished using various combinations of approach paths, flare paths, and error signals. The results of these tests as well as design changes and future program requirements are discussed. Author

N65-16332# Federal Aviation Agency, Atlantic City, N.J. Experimentation Div.
EXPERIMENTATION WITH FLARESCAN VERTICAL GUIDANCE LANDING SYSTEM Final Report
V. Bencivenga Nov. 1964 110 p refs
(RD-64-150)

Static and dynamic tests were conducted on Flarescan, a vertically scanned microwave guidance system, to determine its suitability for use in an all-weather landing system. Areas of investigation included low-angle coverage, position determining accuracy, siting effects, noise content, scan rate, scan direction, method of signal coding, type of antenna pattern, weather effects, interference susceptibility, and optimum flight path characteristics. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-15608# Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM Quarterly Progress Report, 1 Jul.–30 Sep. 1964
R. H. Chesworth 13 Nov. 1964 86 p refs
(Contract AT(10-1)-880)
(IDO-28637)

Summarized is the technical progress of the Gas-Cooled Reactor Systems Program to develop a mobile, low-power, nuclear powerplant for military field operation. ML-1 powerplant testing was resumed on September 1, 1964, and the onstream factor for the month was 77%. Laboratory studies of corrosion of aluminum in shield solution were completed. Corrosion was attributed to heavy metal ions and chlorides in the shield solution. Limits were established for ML-1 operation. The final report of the full power and limited endurance run of the ML-1 (ANSOP 16625A) indicates that the power output of the t-c set during this test was lower than predicted. The shielding performed somewhat better than predicted. Author

N65-15617# Tracerlab, Inc., Richmond, Calif.
ANALYSIS OF HIGH-ALTITUDE FILTER AND IMPACTOR MEDIA FOR EVALUATION OF PROPOSED SNAP REENTRY EXPERIMENT USING NONRADIOACTIVE TRACER Final Report
Walter D. Holland, Chester E. Gleit, Phillip A. Benson, Robert C. Wrigley, and Leon Leventhal Kirtland AFB, N. Mex., AF Weapons Lab., Sep. 1964 150 p refs
(Contract AF 29(601)-5221)
(TLW-1092; WL-TDR-64-68; AD-608123) OTS: $5.00

This study evaluates the feasibility of using simulator elements as tracers to determine the potential hazard involved in atmospheric reentry of SNAP devices. The most satisfactory collection medium was found to be IPC Grade 107 cotton base paper. A more detailed study of IPC paper indicated wide variations between specimens of paper taken from an individual lot. Analysis of special flown samples of IPC determined that uranium was present in the atmosphere, but no other elements were detected above media background. The practicality of using available sampling systems for a reentry experiment employing 25 kc rhenium or thulium was demonstrated for immediate fallout of > 100μ radius particles. Author

N65-15839# Brookhaven National Lab., Upton, N.Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW, VOLUME 2, NUMBER 5, OCTOBER 1964 Bimonthly Technical Progress Review
O. E. Dwyer, ed. Dec. 1964 45 p
(BNL-896(PR-11)) OTS: $3.00

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N65-15858# Hanford Atomic Products Operation, Richland, Wash.
QUARTERLY PROGRESS REPORT, METALLURGY RESEARCH OPERATION, JULY, AUGUST, SEPTEMBER 1964
J. J. Caldwell et al 15 Sep. 1964 148 p refs
(Contract AT(45-1)-1350)
(HW-84281) OTS: $4.00

Research is reported in four areas: physical metallurgy, reactor metals, chemical metallurgy, and materials engineering. Major reports are included on the swelling of irradiated fissionable materials, the irradiation facilities operation, ATR gas loop support, and the Plutonium Recycle Test Reactor (PRTR) pressure tubes. D.E.W.

N65-15859# Hanford Atomic Products Operation, Richland, Wash. Reactor and Fuels Lab.
PROGRESS IN GRAPHITE RESEARCH: A SUMMARY OF HANFORD LABORATORIES ACHIEVEMENTS IN THIS PROGRAM UNDER GENERAL ELECTRIC, 1956–1964
R. E. Nightingale Oct. 1964 32 p refs
(Contract AT(45-1)-1350)
(HW-83604) OTS: $2.00

The following topics were studied to develop the understanding and technology required for the use of graphite in all types of reactors: *Radiation Damage in Graphite*—radiation induced contraction of graphite-moderated reactors, the accumulation of total stored energy at various irradiation temperatures, and the changes in thermal conductivity; *Neutron Dosimetry*—the activation of fast-neutron threshold detectors, such as nickel or iron; *Gas-Graphite Reactions*—the thermal reactions of graphite with oxygen, water vapor, and carbon dioxide; *Cooperative Graphite Development Studies with Carbon Companies;* and *Technical Exchanges with Other Nations*. G.G.

N65-15868# Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
SPECULATIONS ON THE INTERPRETATION OF NEUTRON NOISE EXPERIMENTS
R. K. Osborn Jan. 1965 78 p refs
(Contract W-7405-ENG-26)
(ORNL-3757) OTS: $3.00

Presented are lectures on a theoretical review of the connection between microscopic cause and macroscopic effect of neutron fluctuations. Particular emphasis was placed on the availability and applicability of a physical theory of neutron distributions which eliminates the necessity for the exercise of intuition in establishing connections between macroscopic observables and microscopic dynamics. An exhaustive exploration of the derivations of the equations and their implications for interpretation of power spectral density measurements on nuclear reactors is given. Areas of study include power spectral density, neutron fluctuations in reactors, noise analysis, the influence of spatial variation, and speculations about the role of the detector in the interpretations of power spectral density measurements. Thoughts on external circuitry and the filter output for an oscillator input are added. R.E.S.

N65-15902# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
CONTINUOUS SCANNING X-RAY ATTENUATION TECHNIQUE FOR DETERMINING FUEL INHOMOGENEITIES IN DISPERSION CORE FUEL PLATES
B. E. Foster, S. D. Snyder, and R. W. Mc Clung Jan. 1965 26 p
(Contract W-7405-ENG-26)
(ORNL-3737) OTS: $2.00

A sophisticated technique was developed and successfully used for high-speed homogeneity evaluation of reactor fuel plates. Industrial X-ray equipment is used as the irradiation source, while a NaI (T1) crystal optically coupled to a photomultiplier tube serves as the radiation detector. Careful control of the operating conditions produces very accurate and reproducible results. The method uses the X-ray attenuation principle, and on recent applications the area of evaluation was somewhat smaller than 0.007 $in.^2$. Precision mechanical X-Y scanning of the fuel plate is accomplished with longitudinal speeds of 0 to 150 in./min and horizontal indices of 0 to 5 in. in 0.0005-in. increments. The system is provided with recording capabilities for continuous quantitative data or automatic readout for a go-no-go operation. Tolerance limits are set by a series of programed equivalent attenuation standards at the beginning of each longitudinal pass of the fuel plate through the X-ray beam. A detailed explanation is given on the techniques for fabricating the equivalent attenuation standards. Author

N65-16075# Argonne National Lab., Ill. Reactor Physics Div.
FLUX TRAP EXPERIMENTS IN D_2O-MODERATED THORIA-URANIA CORES
K. E. Plumlee Oct. 1964 35 p
(Contract W-31-109-ENG-38)
(ANL-6915) OTS: $2.00

Experiments are reported involving 25 D_2O and 3 small H_2O internal thermal columns (ITC), or flux traps, inside annular thoria-urania cores. The moderator and the radial reflector were D_2O. Several different fuel densities were used. The ITC's were as large as 104 × 104 cm. Radial activation plots indicated central peaks up to 10 times the fuel zone average at the midplane, and 5 times the fuel zone maximum. Available fuel and facilities were used to obtain data for evaluation of computational methods. The limited selection of fuel prevented optimization of experimental cores. Author

N65-16102# Argonne National Lab., Ill. Idaho Div.
THEORETICAL STUDY ON THE TRANSFER FUNCTION OF BORAX-V WITH CENTRAL SUPERHEATER
Jiro Wakabayashi Aug. 1964 42 p refs
(Contract W-31-109-ENG-38)
(ANL-6926) OTS: $2.00

An analytical, overall, reactor transfer function was derived to examine the stability problems of the BORAX-V boiling water reactor having an integral central superheater. Special consideration was given to local pressure and time delay of void formation caused by superheating of the water. For this analysis, the boiling core was divided into inner and outer parts to introduce the effects of the radial flux distribution. Where appropriate, the analyses were individually done for these two boiler regions and the central superheater region, and the feedback effects were combined. Basic assumptions introduced into the analyses are that (1) the flux deviation is proportional to the initial flux; (2) the power generation in the boiler (UO_2 pellets) and the superheater (UO_2 stainless steel cermet) is proportional to the overall reactor flux distribution; i.e., no spatial kinetic effects are considered; and (3) the individual reactivity phenomena (i.e., local temperature and void changes) are first-power flux weighted to obtain the effective reactivity changes. Author

N65-16103# Du Pont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Lab.
MEASUREMENT OF MIGRATION AREA AND ANISOTROPY IN A MOCKUP OF THE EL-4 LATTICE
Albert E. Dunklee and Warren B. Rogers Nov. 1964 69 p refs
(Contract AT(07-2)-1)
(DP-919) OTS: $3.00

The mockup lattice had a square lattice pitch of 23.09 cm and was fueled by 19-rod clusters of 1.27 cm diameter natural uranium rods inside air-filled 12.7 cm diameter housing tubes. Bucklings were determined for various pile shapes by measured flux profiles. Detailed studies were made of the diffusion properties of the lattice with emphasis on the anisotropic diffusion due to the neutron streaming in the air-filled channels. Such studies included determination of the axial migration area by neutron poisoning techniques as

well as by observation of the neutron kinetics of the pile on stable positive periods. Ratios of axial to radial migration areas were deduced from the buckling measurements on the different shaped piles. Measurements of radial and axial diffusion coefficients were made by activation techniques and by measurements of the reactivity effect of introducing D_2O into coolant channels of selected pile positions. Agreement of the measurements with theoretical predictions was generally good. Author

N65-16171# Bussard (R. W.), Los Angeles, Calif.
NUCLEAR SOURCE LIMITATIONS FOR DIRECT CONVERSION DEVICES
R. W. Bussard [1964] 35 p refs Presented at the 6th AGARD Combust. and Propulsion Colloq., Energy Sources and Energy Conversion, Cannes, France, 16–20 Mar. 1964

Surveys of energy conversion systems, nuclear source limits and potentialities, and characteristics of advanced solid fuel fission reactors and internal direct conversion gaseous fuel fission reactors produce these conclusions: (1) Solid fuel nuclear sources will not likely yield cycle temperatures above 3000° C. (2) Direct conversion by PTC systems external to the source can yield Carnot efficiencies above 0.8 for ground power systems. (3) Ultrahigh temperature gas core reactor systems seem unpromising for ground station use, but may be twice as efficient as advanced solid-core systems for space power use. (4) Fusion-plasma direct-conversion systems (if proven feasible) do not seem to show any greater promise than gaseous fission systems, but are of interest because of fuel availability. R.E.S.

N65-16186# Atomic Energy Commission, Washington, D.C. Div. of Reactor Development
NUCLEAR ENERGY SOURCE LIMITATIONS FOR DYNAMIC ENERGY CONVERSION SYSTEMS
Frank K. Pittman and Joseph D. Lafleur, Jr. [1964] 24 p refs Presented at the 6th AGARD Combust. and Propulsion Colloq. on Energy Sources and Energy Conversion, Cannes, France, 16–19 Mar. 1964

The limitations which the nuclear energy source imposes on the dynamic power system fall into two categories. First, because of the premium which the space environment places on high temperature operation, materials throughout the system are called on to operate at high temperatures. Since the heat source must operate at the highest temperature of the cycle, the reactor fuel temperature is a potential limitation on cycle performance. Second, the nuclear radiation which accompanies the release of nuclear energy will require shielding or hardening to reduce the harmful effects on spacecraft components, and shielding to prevent injury to crews. The nuclear powerplants will be the best, and in many cases, the only, means of meeting many future space power needs. Therefore, these limitations and the associated development problems were identified and are being solved. Author

N65-16197# Commissariat a l'Energie Atomique, Saclay (France). Service d'Electronique Physique
ON A DEVICE FOR THE CONVERSION INTO ELECTRICITY OF IONIZING ENERGY EMITTED BY A NUCLEAR REACTOR [SUR UN DISPOSITIF DE CONVERSION, EN ELECTRICITE, DE L'ENERGIE IONISANTE ISSUE D'UN REACTEUR NUCLEAIRE]
Siegfried Klein and Pierre Kraus [1964] 12 p refs *In* FRENCH Presented at the 6th AGARD Combust. and Propulsion Colloq., Cannes, France, 16–20 Mar. 1964

The phenomena of electrical energy flow in thermocouples led to the use of such a device with a nuclear reactor to demonstrate the possibility of similarly directing the conversion of the kinetic energy of the ionized products of nuclear fission into electrical energy. The results were based on five premises: (1) The neutron flow can easily be carried to 5×10^{14} neutrons per cm^2. (2) The deposit of concentrated uranium oxide can be 2 mg/cm^2. (3) The water vapor, whose potential ionization is 12.56 V, can be advantageously replaced by the vapor of cesium; the ionization potential of cesium is 3.87 V. (4) The pressure of 100 mm of mercury within the device can be increased to atmospheric pressure. (5) Finally, the electrical power generated increases proportionally with the density of the charge in the device, whereas with the use of a nuclear reactor it would be possible to realize ionization of all the vapor so that the electrical energy generated would be considerably greater. R.E.S.

N65-16209# Martin Co., Baltimore, Md. Nuclear Div.
STRONTIUM 90-FUELED THERMOELECTRIC GENERATOR POWER SOURCE FOR FIVE-WATT U.S. COAST GUARD LIGHT BUOY, JUNE 1962–MARCH 1964
W. Kenneth Nichols, Jr. and William A. Mc Donald Apr. 1964 35 p Addendum I to MND-P-2720
(Contract AT(30-1)-3043)
(MND-3043-1; MND-P-2720, Addend. I)

An investigation of the SNAP 7A power degradation revealed an internal gas pressure buildup resulting in excessive heat loss, and an increase in the thermoelectric system's internal resistance. Corrective measures that appear to have solved the problems are outlined. A possible cause of the power degradation was thought to be due to the presence of Strontium 89 in the fuel; however this was not substantiated during the evaluation of the generator. A chromatographic analysis of the generator gas revealed a contamination of the helium by decomposition particles of the phenolformalaldehyde resin that was used as a binder in the thermal insulation, and an adsorption of atmospheric gases and water vapor to the surface of the insulation. A new insulation and the use of pure tin for hot junction bonding material resulted in an efficient power generator construction. G.G.

N65-16211# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.
IODINE VAPOR ADSORPTION STUDIES FOR THE NS "SAVANNAH" PROJECT
R. E. Adams and W. E. Browning, Jr. Feb. 1965 45 p refs
(Contract W-7405-ENG-26)
(ORNL-3726) OTS: $3.00

An experimental program was undertaken to determine the efficiencies of the iodine sorption systems installed aboard the NS Savannah to prevent escape of radioiodine from the reactor compartment in the event of a reactor accident. Laboratory tests conducted under accident conditions on charcoal-adsorber units, reduced in scale but otherwise identical with those in the ship, showed their efficiency to be 99.86% ±0.07% at the 95% confidence level. Two methods were developed for in-place testing of adsorber systems, one using ^{131}I with radioassay and the other using ^{127}I with activation analysis. Both methods were applied on board the NS Savannah; the ^{131}I method was rapid and more sensitive but required precautions to avoid accidental release of ^{131}I; the ^{127}I method was slow and less sensitive but required fewer safety precautions. It was concluded, based on results from both laboratory study and shipboard testing, that the adsorber system as installed on the ship could be expected to retain iodine with an efficiency of 99.86% in the event of an accident. Author

N65-16233# Atomics International, Canoga Park, Calif.
PROGRESS REPORT FOR SNAP (SYSTEMS FOR NUCLEAR AUXILIARY POWER) GENERAL SUPPORTING TECHNOLOGY, August–October 1964
L. S. Mims and R. G. Courson 30 Jan. 1965 25 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10496) OTS: $2.00

Comparisons of ZrH_x spectral calculations with experimental data are given. Computer design studies of the neutron collimator for the STIR are discussed. Calculated and observed hydrogen leakage rates for pulse-heated ZrH_x rods are compared. The results of the MORL applications study are discussed. Author

N65-16275# Argonne National Lab., Ill. Reactor Engineering Div.
STRUCTURAL ANALYSIS OF FARET CORE SUPPORTS UNDER MECHANICAL AND THERMAL LOADINGS
M. M. Chen Sep. 1964 32 p refs
(Contract W-31-109-ENG-38)
(ANL-6778) OTS: $2.00

A general solution was developed for the stress analysis of a core support plate that is subjected to these mechanical and thermal loadings for any rotationally restrained edge conditions. The resulting deflections and stresses were computed for various loading conditions by use of the IBM 704 computer. For the thermal analysis, a rotationally symmetric temperature distribution was assumed, varying linearly through the thickness of the plate. The analysis was based on classical small-deflection theory and the concept of the equivalent solid plate of O'Donnell and Langer. The solution was applied to a model that simulates the FARET core support subjected to a combined mechanical and thermal loading. Author

N65-16315*# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.
STUDY OF RANKINE-CYCLE SPACE NUCLEAR POWER SYSTEMS
A. Lucile Cox and Roy W. Blanton, Jr. Aug. 1964 230 p refs
(Contract NAS8-5289)
(NASA-CR-60553; R-113) OTS: HC $6.00/MF $1.25

Effects of various parameters on the specific weight are presented for a number of configurations and operating fluids. It is shown that when shielding for manned vehicles is required, the minimum specific weights occur at temperature ratios across the turbine much lower than the 0.75 generally found for unmanned systems. Suggestions for improved power systems are included. Author

N65-16335# Los Alamos Scientific Lab., N. Mex.
THE OMEGA WEST REACTOR Status Report
Robert Kandarian and Herbert T. Williams 8 Jan. 1965 70 p refs
(Contract W-7405-ENG-36)
(LA-3116) OTS: $3.00

The Omega West Reactor (OWR) is a thermal, heterogeneous, tank-type research reactor operated by the Los Alamos Scientific Laboratory. The reactor is light-water moderated and cooled, and utilizes aluminum-clad fuel elements of the Materials Testing Reactor (MTR) type. At the normal operating power of 5 MW thermal, the reactor provides neutron fluxes up to 6×10^{13} n/cm^2-sec in the accessible experimental facilities. These facilities include 7 horizontal-beam ports, a thermal column with 20 access ports of various sizes, 3 rabbit tubes, 2 air-filled vertical ports, and 4 in-core irradiation positions. Although the reactor was designed primarily as a research machine, it also serves as a test facility in support of the Laboratory's programmatic activities. This report describes the reactor, its auxiliary systems, and its mode of operation. The extent of the radiation hazards to the public that might result from a nuclear excursion in the reactor is reexamined. Author

N65-16338# Oak Ridge National Lab., Tenn.
GAMMA RADIATION DAMAGE AND DECONTAMINATION EVALUATION OF PROTECTIVE COATINGS AND OTHER MATERIALS FOR HOT LABORATORY AND FUEL PROCESSING FACILITIES
G. A. West and C. D. Watson Feb. 1965 40 p refs
(Contract W-7405-ENG-26)
(ORNL-3589) OTS: $2.00

Protective coatings and other plastic materials were evaluated by irradiation in a gamma source and by decontamination tests for possible use in hot laboratories and fuel processing facilities. Materials used may be subjected to gamma exposures of 10^4 to 10^5 r/hr and neutron exposures of 4.2×10^4 to 2.1×10^5 neutrons/cm^2/sec. Epoxy, modified phenolic and inorganic zinc protective coatings were superior to the other generic types tested in radiation environments. Exposure to radiation in the presence of water decreases the serviceable life of organic coatings about 50%. For example, the best coating, epoxy, was found to be serviceable in water exposure up to about 5×10^9 r and in air, surprisingly, up to 1×10^{10} r. Vinyls and glossy epoxies were superior to the other coatings in decontaminability. Among a group of miscellaneous material tested, a nonmetallic plastic heat transfer compound was unaffected at 1×10^{10} r exposure in air. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-15514# Texas Western Coll., El Paso. Schellenger Research Labs.
QUARTERLY STATUS REPORT, JULY–SEPTEMBER 1964
J. R. Provencio, B. F. Smith, Carlos Mc Donald, and Robert L. Schumaker 20 Oct. 1964 32 p refs
(Contract DA-29-040-ORD-2410)
(AD-451209)

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2. ACOUSTIC HUMIDITY SENSOR C. McDonald 10 p refs (See N65-15516 06-23)

3. DATA ANALYSIS CENTER R. L. Schumaker 11 p

N65-15515 Texas Western Coll., El Paso. Schellenger Research Labs.
SOUND PROPAGATION IN THE SHADOW ZONE EXPERIMENT

J. R. Provencio and B. F. Smith *In its* Quart. Status Rept., Jul.–Sep. 1964 20 Oct. 1964 10 p refs (See N65-15514 06-23)

The temperature gradient in a heated shock tube, as determined by thermistor measurements, was plotted for a 50-cm section of the viewing chamber. Photographs of the shock front, as obtained with the schlieren equipment, were traced onto the plot of isothermal lines. In these and previous experiments, the measured value of the shock deflection was five times larger than the previously calculated estimates. In order to improve the reliability of these experimental determinations, different methods were used to heat the top plate, and more accurate temperature measurement methods were studied. Several changes in the power and configuration of the heating elements, the addition of external insulators, and repositioning of the equipment to apply heat over a longer section of the tube improved the overall uniformity of the temperature gradient. To reduce the probable error in temperature measurement, due to uncertainties in thermistor calibration and scale-end meter readings, a different meter was used with the same thermistors. Deflection measurements following these changes produced results somewhat more consistent with calculations. E.P.V.

N65-15516 Texas Western Coll., El Paso. Schellenger Research Labs.

ACOUSTIC HUMIDITY SENSOR

Carlos Mc Donald *In its* Quart. Status Rept., Jul.–Sep. 1964 20 Oct. 1964 10 p refs (See N65-15514 06-23)

Investigation of the change in speed of sound with water vapor content was completed, and the results are presented. Quantitative relationships were established for the effect of variation of humidity on sound absorption. Experimental work was performed on wideband, large surface area, electrostatic transducers. Results indicate that these tranducers respond up to at least 100 kc with little or no phase shift characteristics. This type of electrostatic transducer makes possible better and simpler methods of measurement for speed of sound and sound absorption. E.P.V.

N65-15534*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MAGNETIC SUSCEPTIBILITIES OF COMPOSITIONS IN TANTALUM—TANTALUM CARBIDE SYSTEM

Gilbert J. Santoro Washington, NASA, Jan. 1965 13 p refs (NASA-TN-D-2638) OTS: HC $1.00/MF $0.50

In the tantalum–tantalum carbide (Ta-TaC) system, magnetic susceptibility measurements were performed on powder samples, and lattice parameter determinations were conducted on powder and filament specimens. A maximum diamagnetism was observed at $TaC_{0.8}$. The entire Ta_2C phase proved to be paramagnetic, and evidence indicated the zeta phase to be diamagnetic. The dissolution of carbon in tantalum reduced its paramagnetism. The minimum in the susceptibility at $TaC_{0.8}$ could be accounted for by applying the bonding concepts of either Bilz or Dempsey, although their approaches are basically different. Lattice parameters were determined on the powder samples throughout the entire tantalum–tantalum carbide system and on the filament samples in the TaC phase. The variation in the lattice parameter was nonlinear in the high-carbon end of the face-centered-cubic phase region. The X-ray data from the carbide filament specimens agreed with those from the powder specimens and with the previously reported data from filaments. Author

N65-15569 Naval Ordnance Lab., Corona, Calif.

THE FIRST SPECTRUM OF XENON IN THE 4-MICRON REGION AND ITS INTERPRETATION

C. J. Humphreys and E. Paul, Jr. *In its* Foundational Res. Proj. 1 Jun. 1963 p 33–39 refs (See N65-15565 06-34)

Equations supplied by R. D. Cowan are presented which describe the distribution of the pairs and the pair splittings for the p^5g and p^5f configurations in pure jK (Cowan's terminology) coupling. The separations obtained from the equations were nearly true for the 4f levels of NeI. ArI. describe the distribution of the pairs and the pair splittings suggested. Further investigation is necessary to obtain useful information from the pair splitting results. (R&DA)

N65-15650# Carnegie Inst. of Tech., Pittsburgh, Pa.

INFLUENCE OF THE INTERNAL FIELD ON THE RESIDUAL RESISTANCE OF VERY PURE IRON

L. Berger and A. R. de Vroomen (Nijmegen U., Holland) 15 Nov. 1964 9 p refs Submitted for Publication

(Contract Nonr-760(05))

(TR-27; AD-451401)

It is shown that the field B = 22 kG that exists in each Weiss domain even in the absence of an applied field should cause certain anomalies in the residual resistance of very pure iron. The residual resistance in zero applied field is no longer proportional to impurity concentration. It may even have a minimum as a function of impurity concentration. The minimum should correspond to a resistivity ratio $R_{273}/R_{4.2}$ of roughly 300. This explains why the resistivity ratio of samples of zone-refined iron is usually found to be no higher than 200 or 300. The same internal field is also shown to be the cause of the resistance decrease in a small longitudinal field, observed in very pure iron and nickel at low temperature. A decrease is also expected in a small transverse field if the sample is very slightly misoriented. Author

N65-15653# Picatinny Arsenal, Dover, N.J. Ammunition Engineering Directorate

INVESTIGATION OF GYROSCOPIC EFFECTS ACTING ON RAPIDLY ROTATING AND MOVING ROD BUNDLES

William J. Lohninger Oct. 1964 65 p refs

(PA-TM-1512; AD-451323)

Considered are only precessional effects acting on: (1) assemblies of a determined number of individual rapidly spinning rod bundles; and (2) single rapidly spinning and moving rod bundles. Case 1 is given when the individual rod bundles of an assembly are set into rotation with a desired rotational speed of 3600 rpm, either before or after launch (that is, before ejection of the bundles). Case 2 is present either shortly before, during, or after ejection of the bundles. For simplification, it is assumed that the prelaunch or afterlaunch rotation of the bundles is accomplished by compressed gas jets; and the increased spin, before, during, or after ejection is achieved by tangential rocket jets. Author

N65-15692# Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J. Electronic Components Dept.

AN ANALYSIS OF DIRECTIONAL VIEWING SCREENS: A COMPARISON TO A MATTE-WHITE SURFACE

Rex S. Sinclair Sep. 1964 18 p refs

(ECOM-2500; AD-609034)

Screens used for viewing projected images were analyzed to consider the effect on brightness as a function of viewing angle caused by making the screen directional in its reflective properties. In each case, the screen was compared to a matte-white surface. This surface has the property of brightness being a constant at all viewing angles. Three screens are considered:

a beaded screen and two hypothetical screens. The beaded screen is the most directional screen commercially available. Author

N65-15718# Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
[A SUMMARY OF CURRENT RESEARCH IN ELECTROMAGNETICS, PLASMA ELECTROPHYSICS AND ELECTRONICS, SOLID STATE AND MATERIALS RESEARCH, MICROWAVE CIRCUITS, NETWORK THEORY, AND SYSTEMS, COMMUNICATIONS, AND CONTROL] Progress Report No. 26, 1 Apr.–30 Sep. 1964
Ernst Weber [1964] 149 p refs
(Contract AF 49(638)-1402)
(R-452.26-64; AD-609133)

CONTENTS:

1. ELECTROMAGNETICS H. M. Altschuler et al p 1–32 refs
2. PLASMA ELECTROPHYSICS AND ELECTRONICS L. Bergstein et al p 33–56 refs
3. SOLID STATE AND MATERIALS RESEARCH H. M. Altschuler et al p 57–71 refs
4. MICROWAVE CIRCUITS H. M. Altschuler et al p 72–92 refs
5. NETWORK THEORY H. M. Altschuler et al p 93–100 refs
6. SYSTEMS, COMMUNICATIONS, AND CONTROL J. V. Abbate et al p 101–138 refs

N65-15770# Naval Missile Center, Point Mugu, Calif. Controls Div.
A METHOD OF PREDICTING TOTAL DYNAMIC UNBALANCE AFTER THE JUNCTION OF TWO DYNAMICALLY UNBALANCED STAGES
R. O. Wilke 5 Jan. 1965 42 p refs
(NMC-MP-64-11; AD-455071)

Although the exact unbalance in an assembled configuration may not be precisely determined, the upper bound unbalance in a total configuration not conducive to dynamic balancing can be defined. The mathematical model used two statically and dynamically unbalanced rigid bodies, and the extremization procedure resulted in an unbalance limit, which is a function of the individual balancing tolerances of each body, both static and dynamic. Assemblage errors also contributed to dynamic unbalance, and an expression was derived for treating the free-space coning angle as a function of static and dynamic unbalance, concentricity error, and parallelism error. Terminology was clarified, and corrective measures and suggestions for various type vehicles were included. Results showed that two dynamically unbalanced vehicles could be combined, and the total configuration will not exceed the specified upper bound unbalance. M.G.J.

N65-15792# Hayes International Corp. Birmingham, Ala.
THEORETICAL AND EXPERIMENTAL STUDY OF DETONATION WAVE REINFORCEMENT AND SHAPING TECHNIQUES
Eglin AFB, Fla., Res. and Technol. Div., Dec. 1964 33 p refs
(Contract AF 08(635)-3624)
(ATL-TR-64-80; AD-454577)

A study was performed to determine the design criteria for a shaped charge and the associated liner geometry, employing wave shaping techniques. Heretofore, shaped charge jets were characterized by a velocity gradient along the jet. The objective was to design a shaped charge that would produce a jet characterized by a uniform velocity. Such a jet would be projected downrange essentially as a single particle rather than a spray of fine particles. Parametric equations for a wave shaping lens were solved by an internally programed digital computer. The proposed shaped charge design, featuring a cylindrical, metallic liner and a wave shaping lens of polypropylene plastic, was fabricated, and test firings were accomplished. Author

N65-15798# Hamburg U. (W. Germany).
CONTRIBUTIONS TO ACTUAL PROBLEMS OF GENERAL RELATIVITY Final Report No. III
Pascual Jordan, W. Beiglböck, K. Bichteler, W. Budich, W. Kundt et al 1964 107 p refs
(Contract AF 61(052)-567)
(ARL-65-24; AD-455081)

Discussions are given of the consistency of Abraham's electromagnetic energy-momentum-tensor with relativistic nonequilibrium thermodynamics in continuous media, of exterior differential calculus for spinor forms in general relativity, of a three-dimensional formulation of the Bianchi identities for vacuum gravitational fields, and of temperature equilibrium in stationary space-times. D.E.W.

N65-15834# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
METHODS FOR LOWER BOUNDS TO FREQUENCIES OF CONTINUOUS ELASTIC SYSTEMS
Norman W. Bazley (Battelle Mem. Inst., Geneva) and D. W. Fox Oct. 1964 73 p refs
(Contract NOw-62-0604-c)
(TG-609; AD-608356)

Recently developed mathematical methods are presented for the calculation of rigorous lower bounds for the frequencies of continuous linear elastic systems in free vibration. Some fundamental properties of vibrating elastic systems are discussed, and the general form of the differential equations and boundary conditions is presented; then the vibration problem is formulated as an eigenvalue problem for operators in Hilbert space, and is characterized variationally in terms of the bilinear and quadratic forms associated with the operators. Two methods for the calculation of lower bounds are developed that are based on the use of comparisons of quadratic forms in Hilbert space and on the systematic use of Bessel's inequality. Four examples of lower bound calculations for problems from beam theory are presented. D.S.G.

N65-15854# California U., Berkeley. Lawrence Radiation Lab.
PHYSICS DIVISION SEMIANNUAL REPORT, MAY–OCTOBER 1964
Luis W. Alvarez et al 16 Nov. 1964 76 p refs
(Contract W-7405-ENG-48)
(UCRL-11776) OTS: $3.00

The work in general physics research and accelerator operation and development was continued. Major studies were performed in research with bubble chambers; the decay of K^+ mesons and an evaluation of K^- -meson interactions; the theory of the scattering matrix; particle physics; many-body physics; plasma physics; accelerator design; mathematics and computing; the charge-exchange interactions in elastic pion-proton scattering; and accelerator parameters. G.G.

N65-15856# Wayne State U., Detroit, Mich.
REMARKS ON REFRACTIVE INDEX MIXTURE RULES
Wilfried Heller 28 Jul. 1964 20 p refs Submitted for Publication
(Contract Nonr-3511(00))
(TR-11(57); AD-608337) OTS: $1.00

The most important refractive index mixture rules used for determining the refractive index of a solute were scrutinized regarding their relative merits and interrelations. The Dale–Gladstone and the Biot–Arago equations were found to follow from either the Lorentz–Lorenz equation or the Weiner equation if the solution were dilute and if, in addition, the refractive indices of solute and solvent were nearly the same. A proposed mixture rule represents the limiting form of the Wiener equation, in the case of dilute solutions without restriction of the value of the refractive indices. The performance of all equations was tested on literature data. The results were in line with expectation, on the basis of theoretical analysis. The special case of solutes of colloidal dimensions, where none of the equations applies satisfactorily, is briefly discussed. Author

N65-15904# Brandeis U., Waltham, Mass.
POSITRON ANNIHILATION RATE IN AN ELECTRON GAS
Birger Bergerson (Ph.D Thesis) May 1964 136 p refs
(AD-608291)

A discussion is given of different computational methods for the evaluation of the positron annihilation rate in an electron gas, and a comparison is given with experimental data for positron annihilation in certain metals. Special emphasis is put on the consistency requirements of the problem, these being (1) the polarization cloud around the positron should have unit charge, (2) the electron positron and electron electron pair correlation function be positive definite even if the positron charge is varied, and (3) the Nozieres and Pines sum rule for the dielectric constant should be satisfied. A detailed discussion is given on how these requirements are taken into account in perturbation theory. Finally, a specific ansatz is made for the polarization cloud around the positron in terms of a bound state wave function orthogonalized to a set of deformed plane waves. Author

N65-15981# Columbia U., New York, N.Y. Inst. for the Study of Fatigue and Reliability
RANDOM VIBRATION OF A BEAM COLUMN
M. Shinozuka Oct. 1964 32 p refs
(Contract Nonr-266(91))
(TR-10; AD-608606)

The response of a uniform vertical cantilever beam to a horizontal random motion of the fixed end and a vertical load at the free end is discussed, and the space average of the mean square displacement is computed as a measure of the response. This problem, which does not appear to have been solved for random motion, may be considered a simplified model of many actual structures, e.g., the tower of suspension bridges under horizontal earthquake acceleration. Author

N65-15995# J. G. Engineering Research Associates, Baltimore, Md.
APPROXIMATION TO THE MEAN SQUARE FARFIELD PRESSURE OF RANDOMLY VIBRATING STRUCTURES AT LOW FREQUENCIES
Joshua E. Greenspon Nov. 1964 16 p refs
(Contract Nonr-2733(00) FBM)
(TR-12; AD-609634)

A relation between the cross spectral density of the far-field pressure outside a surface surrounding a sound source is derived in terms of cross spectral density of the normal acceleration over a surface surrounding the source. The cross spectral density of the acceleration is given in terms of the modes of the structure. A resulting simple formula for the mean square far-field pressure in low-frequency bands is derived using simple source Green's functions. Author

N65-16006# Air Force Cambridge Research Labs., Bedford, Mass.
ENERGY MOMENTUM CONSERVATION AND SOME OF ITS CONSEQUENCES FOR THE CLASSICAL PARTICLE
E. J. Post Dec. 1964 27 p refs *Its* Phys. Sci. Res. Papers No. 68
(ARCRL-64-954; AD-610070)

Mechanical energy and momentum (e-m) has an equivalent counterpart in electromagnetic energy and momentum (e-m) and vice versa if conservation is assumed for the sum of these two fundamental manifestations of e-m. The classical particle concept is reconsidered in the spirit of Kwal's emphasis on an invariant relation between the e-m tensor and the e-m vector. The notion of a mass-carrying particle is specified by introducing a concept of physical rigidity which permits a straightforward definition of states of rest and motion of particles and their associated fields. It then follows that an optional electromagnetic interpretation of rest mass applies to every particlelike object which in a rest frame is surrounded by an electrostatic or a magnetostatic field. The conclusion also holds for particles characterized by a combination of an electric monopole and a magnetic dipole, provided some simple symmetry requirements are met. The electromagnetic option for a neutral particle without a magnetic moment but with a rest mass is that of a (temporarily) trapped standing wave. Author

N65-16043# California Inst. of Tech., Pasadena.
[STUDY OF MOLECULAR FORCES AND CONFIGURATIONS IN LIQUIDS] End of the Year Report
Cornelius J. Pings 6 Oct. 1964 5 p refs
(Contract Nonr-220(40))
(AD-354232)

Experimental studies of the molecular level in liquids were continued with X-ray diffractions of liquid argon, pure gallium metal, and liquid gallium–mercury mixtures. Data on 14 argon states in the hypercritical region were analyzed, and proved that reports of previously observed second coordination shells were false. Refractory index measurements on argon, methane, and carbon tetrafluoride along the vapor pressure point were completed and substantiated the Lorentz–Lorenz theory. Velocity and absorption measurements of sound in the critical region of the nitrobenzene–isooctane system were made. Very close to the critical state, the absorption of sound is 40 times larger than the normal classical value, and 15° above the critical state the absorption of sound is more than 12 times that of a normal fluid. G.G.

N65-16067# IIT Research Inst., Chicago, Ill.
EXPERIMENTAL NOISE INVESTIGATION OF MODEL NOZZLES Technical Report, Nov. 1963–Dec. 1964
David F. Pernet Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Dec. 1964 139 p refs
(Contract AF 33(615)-1164)
(AFAPL-TR-64-138; AD-610256)

Fair field sound pressure levels were measured in an anechoic room for noise generated by cold airflow through a wide

variety of small nozzle configurations. These nozzles included converging, converging–diverging, annular plug, annular center core flow, and ejector types. The results are examined in terms of mass flow and acoustic power performance. Thrust determinations were made for selected nozzles showing good acoustic performance, permitting an ultimate evaluation of their acoustic performance in terms of their thrust performance. Optimized nozzles from each of four nozzle configurations are recommended for a full-scale evaluation. These are: a plug, a center core flow, a converging–diverging, and a converging–diverging plug nozzle. The noise generated by hot airflow through a converging nozzle was determined, enabling only partial corroboration of the scaling technique. One of the recommended nozzle types, the plug nozzle, was investigated under hot flow conditions, and its acoustic performance was found to remain superior to that of a converging nozzle. Author

N65-16077# Ohio State U. Research Foundation, Columbus. Antenna Lab.
SOME PROPERTIES OF THE ELECTROMAGNETIC FIELD IN A STRATIFIED LAYER
D. C. Stickler (Ph.D. Thesis) 15 Nov. 1964 67 p refs
(Contract AF 33(615)-1081)
(Rept.-1751-6; AD-453129)

A study was made of the field distribution in an inhomogeneous layer. By examining the Poynting vector and two quadratic forms which are closely related to the energy density, some useful properties of the electromagnetic field were determined for a one-dimensionally stratified medium. New expressions were derived for the upper bounds on the moduli of the electric and magnetic field intensities in a medium in which the permittivity and the permeability may vary as a function of one of the rectangular coordinates. Several numerical examples are presented. Not only are these upper bounds simple to calculate, but they yield more accurate and useful results than the previously available expressions. An estimate is developed for the error involved in the WKB approximation for the field distributions in an inhomogeneous layer, and a numerical example is included. Author

N65-16133# Ohio State U. Research Foundation, Columbus. Antenna Lab.
ON THE COHERENCE PROPERTIES OF A LIGHT BEAM AS MEASURED IN A DOUBLE SLIT DIFFRACTION EXPERIMENT
John Meadors and Seymour Bell 15 May 1964 24 p refs
(Contract AF 33(657)-10824)
(Rept.-1579-11; AD-444723)

In studying the coherence properties of optical radiation via classical diffraction experiments, such as a double slit, it is generally assumed that a high fringe visibility implies an approximately coherent source. However, the question of whether or not poor visibility fringes imply a deteriorated spatial coherence across the slits has not been answered. In this work a mathematical model of the optical field was assumed which accounted for partial coherence, nonuniform illumination of the slits, and the misalignment of the source and the slits. The radiation pattern of the double slits was calculated using the model, and it was found that each of the three mentioned factors influenced the fringe visibility adversely. A simple diffraction experiment can provide information on the lower limit of the degree of coherence of the field, but the actual spatial coherence may be much higher than the fringe visibility would indicate. Author

N65-16169# Queens Coll., Flushing, N.Y.
LORENTZ COVARIANT SCALAR THEORIES OF GRAVITATION A Brief Review
A. L. Harvey Oct. 1964 34 p refs Submitted for Publication
(Grant Nonr(G)-00055-64)
(TR-3; AD-451161)

Theories selected for review were examined for their individual fulfillment of the following requirements: to reduce in a nonrelativistic limit to Newtonian theory, exhibit covariance with respect to the Lorentz group, satisfy the weak form of the principle of equivalence, and be in accord with observational data. The theories discussed include those of Poincaré, Nordström, Bergmann, Thirring, and Kustaanheim. Three classical tests were used to check the predictions of a theory of gravitation. Predictions of red shift and deflection of light rays in the field of a massive object, test, respectively, the influence of the gravitational field on the interaction of radiation with the electron field, and the direct interaction of electromagnetic and gravitational fields. It is concluded that only the third test, the advance of the perihelion, serves to test directly the direct gravitational interaction of the two masses. It is also concluded that the scalar theories of gravitation constructed to date were not successful. D.S.G.

N65-16183# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
THE LONG PERIOD DAMPING CAPACITY OF THIN WIRES IN TORSION
Barry E. Tossman Sep. 1964 67 p refs
(Contract NOw-62-0604-c)
(TG-596; AD-608165)

This research investigates the torsional damping capacity of thin wires subject to long-period forced oscillation. Because the periods of interest are in the order of 10 hours, the direct measurement of damping capacity is impossible. Methods are presented whereby the damping capacity can be predetermined. It is shown that since internal friction is a manifestation of material anelasticty, Boltzmann's superposition theory can be used to develop a functional relation correlating internal friction and creep. The damping capacity of several high-loss wires is determined directly by measuring the logarithmic decrement during a 1-hour period of free vibration, and by measuring the deformation response phase lag during a 1-hour period of forced vibration. These values are compared to predictions derived from the creep–damping function utilizing measured creep data. On the basis of the correlation obtained, a curve of internal friction versus period of oscillation is generated. The high-loss wires are composed of cadmium-plated beryllium copper. The mechanism of internal friction is attributed to viscous damping at the cadmium grain boundaries and dislocation effects. Author

N65-16190# National Bureau of Standards, Washington, D.C.
LINE PARAMETERS AND COMPUTED SPECTRA FOR WATER VAPOR BANDS AT 2.7μ NBS Monograph 71
David M. Gates, Robert F. Calfee, David W. Hansen, and W. S. Benedict 3 Aug. 1964 134 p refs
(ARPA Order 250-61) GPO: $2.00

The spectral line positions, strengths, and half-widths of the ν_1, 2 ν_2, and ν_3 bands constituting the 2.7μ region of water vapor are presented for the range 2857 to 4444 cm^{-1}. Lines attributed to the H_2O^{17} and H_2O^{18} molecules in this region were calculated and included along with the hot lines produced by 030 to 010, 011 to 010, and 110 to 010 transitions. The computations were carried out for values of J through 15. Author

N65-16229# Sandia Corp., Albuquerque, N. Mex.
SOUND RAYS IN THE ATMOSPHERE
R. J. Thompson Jan. 1965 14 p refs
(SC-RR-64-1756)

A system of ordinary differential equations governing ray paths in the presence of winds is derived and discussed. The equations are derived under the assumption that the winds and the speed of sound depend only on altitude. The results are compared with several methods that have been used for finding ray paths approximately. Author

N65-16239# Israel Inst. of Technology, Haifa.
NON-GEODESIC MOTION IN GENERAL RELATIVITY Scientific Report No. 11
Asher Peres 24 Sep. 1964 5 p refs
(Grant AF-EOAR-64-20)
(ARL-65-26; AD-610141)

An exact solution of the Einstein equations is constructed in which a point singularity moves along a trajectory which is not a geodesic of the background space. Author

N65-16248# Polytechnic Inst. of Brooklyn, N.Y.
ON LINEAR EQUATIONS OF ISOTROPIC ELASTIC PLATES AND SHELLS Scientific Report No. 2
Yi-yuan Yu Feb. 1964 37 p refs
(Contract AF 49(638)-1290)
(AFOSR-64-2087; AD-610139)

This paper, gives a modified linearized version, from which the corresponding variational principle for an isotropic shell of arbitrary thickness is deduced by means of the series expansion method. The complete system of shell equations is obtained as the Euler equations. These reduce to Mindlin's result for isotropic plates as a special case. When the infinite series is truncated, the first-order approximation yields for the shell the stress equations of motion of the usual type, the strain-displacement relations given previously by Sanders and, with the exception of those for transverse-shearing stresses and strains, the stress-strain relations that are reducible to those given by Reissner. Author

N65-16249# Polytechnic Inst. of Brooklyn, N.Y.
DAMPING PARAMETERS OF LAYERED PLATES AND SHELLS Scientific Report No. 3
Yi-yuan Yu and Nann Ren Apr. 1964 52 p refs
(Contract AF 49(638)-1290)
(AFOSR-64-2088; AD-610140)

Damping parameters are associated with the various sources of structural or viscoelastic damping, and are functions of the wave number or frequency as well as the ratios between the densities, elastic moduli, and thicknesses of the core and face layers of the sandwich. The product of a damping parameter and the associated loss factor of the material represents their contribution to the samping of the composite plate. Discussions are given of antisymmetrical vibrations of sandwich plates, symmetrical vibrations of sandwich plates, vibrations of two-layered plates, and axially symmetrical vibrations of sandwich cylindrical shells. Diagrams and graphs show the structure of the sandwich materials and their frequency and damping parameters. D.E.W.

N65-16253*# IIT Research Inst., Chicago, Ill. Technology Center
INVESTIGATION OF LIGHT SCATTERING IN HIGHLY REFLECTING PIGMENTED COATINGS Quarterly Report, 1 Aug.–1 Nov. 1964
G. A. Zerlaut, B. H. Kaye, and V. Raziunas 21 Dec. 1964 33 p refs
(Contract NASr-65(07))
(NASA-CR-60531; IITRI-C6018-12) OTS: HC $2.00/MF $0.50

This report contains a detailed discussion of the random-walk technique (for a collapsed cloud) that will be used in an attempt to elucidate the multiple scattering mechanisms in concentrated, polydisperse paint films, and results of continued experiments to determine the optical properties of carefully prepared silver bromide arrays. The random-walk model proposed consists of an idealized series of energy-boundary encounters wherein the paint film is treated in a manner analogous to a series of diffraction screens consisting of random apertures. Integrated reflectance data of silver bromide arrays indicate that in backscatter as in total scatter the particles tend to act as independent scatterers for energy penetration to a depth of from 2 to 4 layers of pigment. Author

N65-16281# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
VARIATIONS IN THE SPEED OF SOUND DUE TO ATMOSPHERIC COMPOSITION
Richard D. H. Low Jan. 1965 13 p refs
(ERDA-253; AD-455554)

By means of a simple error propagation formula, it is shown that the usual variations in atmospheric composition may introduce an error no greater than about 2 cps in the computation of the sound speed and, therefore, should be of negligible concern in the routine utilization of acoustics in either sound ranging or sonic thermoanemometry. Author

N65-16329*# IIT Research Inst., Chicago, Ill.
INVESTIGATION OF LIGHT SCATTERING IN HIGHLY REFLECTING PIGMENTED COATINGS Monthly Progress Report, 1 Aug.–1 Sep. 1963
Gene A. Zerlant [1963] 10 p refs
(Contract NASr-65(07))
(NASA-CR-51393; IITRI-C6018-2) OTS: HC $1.00/MF $0.50

Progress is reported as follows: (1) Crystals of silver bromide were found to be insufficiently stable to permit reproducible reflectance and transmittance measurements: (2) Silver chloride prepared in emulsion gelatin was found to be just as sensitive as silver chloride prepared in stock gelatin: (3) Silver chloride films frozen on aluminum substrates show the same unstable reflectance as silver bromide. P.V.E.

N65-16339# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
STOCHASTIC ANALYSIS OF MULTI-COMPARTMENT SYSTEMS Mathematical Note No. 313
G. Marsaglia Jul. 1963 24 p
(D1-82-0280)

Methods are discussed for describing, mathematically, flows between compartments in a multicompartment system. The conventional theory is given, based on the solution of a system of linear differential equations. A theory based on probability is also given, viewing the system as a collection of states with a particle moving from state to state with certain probabilities, and remaining in each state a random time with an exponential distribution. Finally, a third approach, also based on probability theory, is presented, in which the sojourn time of a particle is considered, that is, the time it spends after leaving a given compartment before returning to that compartment. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-15505 American Optical Co., Southbridge, Mass.
RECENT RESULTS ON ENERGY TRANSFER IN RARE EARTH CHELATES
M. Kleinerman *In* Gen. Telephone and Electron. Labs. Conf. on Org. Lasers 25 May 1964 p 39-57 (See N65-15502 06-16)

A postulated mechanism of energy transfer in lanthanide chelates, which involves a participation of the triplet level of the chelates, is criticized, and the implications for organic laser design are discussed. Reveiwed are the problems of fluorescence efficiency and the high-absorption coefficient of the ligands in laser application of rare-earth chelates. R.L.K.

N65-15530*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DISTORTION OF ATOMIC-BEAM VELOCITY DISTRIBUTIONS DUE TO CLASSICAL HARD-SPHERE GAS SCATTERING
Eugene J. Manista Washington, NASA, Jan. 1965 22 p refs (NASA-TN-D-2617) OTS: HC $1.00/MF $0.50

The concept of the effective scattering cross section that arises primarily in studies of collisions among thermal-energy particles is reviewed. A formulation of the effective scattering cross section is developed from the definition of the collision cross section, and is shown to reduce to the appropriate hard-sphere limit for the case of scattering in the center-of-mass system that is independent of relative velocity. The distortion of the Maxwellian velocity distribution of an atomic beam due to its passage through a classical hard-sphere scattering gas is investigated. The effect of the scattering gas is reduced to a generalized hard-sphere scattering probability function P(z) in which the collision radius d for a motionless scattering gas appears along with a function $\theta(z)$ that takes proper account of the motion of the scattering gas atoms. The function P(z) gives the probability that a beam atom of velocity v undergoes no scattering in passing through a region containing a Maxwellian scattering gas. The parameter z is a reduced velocity that correlates the motion of the scattering gas and the incoming beam atom velocity. Author

N65-15540# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
INTERNAL FIELDS AT IRON IN FePd ALLOYS
George Bemski and Ximenes Alexandrino da Silva 26 Nov. 1963 9 p refs *Its* Notas de Fisica, Vol. 11, No. 4

The Mössbauer absorption by powdered iron-palladium alloy (FePd) of gamma radiation from a source of Co^{57}-diffused stainless steel was studied. Measurements indicated that the internal field, H_i, is approximately constant over the entire range of composition of the alloy, from 4 at.% to 100 at.% of Fe. This field was shown to be identical to the H_i of metallic iron. Data also indicated that the behavior of H_i as a function of temperature for FePd alloys is similar to the behavior of magnetization in metallic iron as a function of T/T_c. It is concluded that iron in FePd alloy is in practically the same magnetic field as in metallic iron, regardless of changes in crystal structure, lattice spacing, and types of neighbors. D.E.W.

N65-15597# Rochester U., N.Y.
PERMUTATION SYMMETRY AND A DERIVATION OF UNITARY SYMMETRY
J. Schechter, Y. Ueda, and S. Okubo 18 Dec. 1964 32 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-68)

Assuming the existence of three basic fields ϕ_1, ϕ_2, ϕ_3 with their linear combinations ψ_1, ψ_2, ψ_3 given by

$$\psi_\mu = \sum_{\nu=1}^{3} a_\mu^\nu \cdot \phi_\nu$$

for some a_μ^ν, the following is proved: The total Hamiltonian, H is invariant under three dimensional unitary group U(3) if H is invariant under permutations of ϕ_1, ϕ_2, ϕ_3 and if H preserves the particle numbers associated with the ψ_μ-fields ($\mu = 1, 2, 3$). This holds in general, except for a very special form of a_μ^ν in which case we obtain instead a broken U(3) symmetry. Author

N65-15601# Frankford Arsenal, Philadelphia, Pa. Research and Development Directorate
MATRICES OF SPIN-ORBIT INTERACTION OF THE f^4 ELECTRON CONFIGURATION
Edith F. Reilly Aug. 1964 29 p refs
(R-1731; AD-451698)

The spin-orbit matrices of the f^4 electron configuration are computed by Racah's method, which separates terms of the same kind. The coefficients of fractional parentage, which are used in the spin-orbit calculation, are also tabulated. Author

N65-15715# Stanford U., Calif. Stanford Linear Accelerator Center
SPECIFICATIONS FOR THE BEAM TRANSPORT SYSTEMS TO END STATIONS A AND B
H. S. Butler, S. K. Howry, and C. H. Moore Jun. 1964 69 p refs
(Contract AT(04-3)-400)
(SLAC-29) OTS: $3.00

Considered are two electron-beam transport systems that contain a series of magnets to provide the necessary deflection for the physical and radiological separation of the experimental areas A and B of a linear accelerator. The end station A is considered primarily for electron and positron scattering and photoproduction experiments, and the end station B is planned for secondary particle production. In addition to deflecting the beam, each transport system will momentum-analyze the beam before directing it toward the appropriate end station. Both systems will be serviced by the same pulsed switching magnet. A set of specification requirements for the transport systems was derived from analytical calculations of the various parameters. G.G.

N65-15748*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POSSIBLE PROTON-ALPHA SCATTERING EXPERIMENTS AT 40 MEV
C. C. Giamati and R. M. Thaler (Case Inst. of Tech.) Washington, NASA, Feb. 1965 15 p refs Also published in Nucl. Phys., v. 59, Oct. 1964 p 159-167
(NASA-TN-D-2657) OTS: HC $1.00/MF $0.50

Two qualitatively different phase-shift analyses of the 40-MeV proton-alpha elastic-scattering and polarization data have appeared in the literature. The question arises whether further experimental data can decide in favor of one or the other of these analyses. Two classes of experiments, measurement of the triple-scattering parameters R and A and measurement of the polarization P in the region of the Coulomb interference scattering cross section minimum, were examined to determine if these provide additional information to resolve the ambiguity. It is concluded that a measurement of the polarization near the Coulomb interference minimum would serve to establish, on a purely experimental basis, the complete scattering amplitude in the forward direction. This information would remove the ambiguity in the phase-shift analysis of these data. No further information could be gained from triple scattering experiments unless these experiments were of very high precision. Author

N65-15817*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science
LABORATORY FOR NUCLEAR SCIENCE PROGRESS REPORT
1 May 1964 135 p refs
(Contracts NASw-37; NASA-2053; NAS5-2952, NAS5-3205; AT(30-1)-2098; et al)
(NASA-CR-60409; MIT-2098-64) OTS: HC $4.00/MF $1.00

Research is reported in these fields: chemistry of the fission elements, inorganic nuclear chemistry, organic nuclear chemistry, cosmic radiation, bubble-chamber analysis, linear accelerator experiments, high energy accelerator physics, isotopic bombardment and decay schemes, radioactivity, cyclotron acceleration, and the theory of nuclei and elementary particles. D.E.W.

N65-15843# Oak Ridge National Lab., Tenn. Isotopes Development Center
ISOTOPES—A PROGRAM FOR NEUTRON PRODUCT YIELDS AND DECAY CALCULATIONS USING A CONTROL DATA 1604-A COMPUTER
Charles W. Friend and Alton R. Jenkins Jan. 1965 25 p refs
(Contract W-7405-ENG-26)
(ORNL-3673) OTS: $2.00

A computer program was developed to calculate the optimum time of neutron irradiation for maximum yield, the specific activity of the product isotope in curies per gram of target material, and the combined specific activity of the target and product isotopes for any general first-order reaction or decay problem. The program was written in the FORTRAN-63 language for the Control Data 1604-A computer. Author

N65-15873# Michigan U., Ann Arbor.
NEUTRINO PRODUCTION OF LEPTON PAIRS
George Nicholas Stanciu (Ph.D. Thesis) 1964 52 p refs
(Contract Nonr-1224(15); Grant NSF GP-1536)
(AD-603251)

The purpose of this study is to calculate the total cross section for the neutrino production of a lepton pair in the Coulomb field of a nucleus under the assumption that the universal four fermion theory of weak interactions is correct at high energies. The total cross section for the neutrino production of a lepton pair in the electromagnetic field of a target particle (spin zero or spin one-half) is written as a sum of two four-fold Lorentz invariant integrals. The electromagnetic form factors are taken from elastic electron scattering experiments. The total cross section for muon pair production by a muon neutrino incident on a free proton and the total coherent cross sections for muon pair production by a muon neutrino incident on two different target nuclei, copper ($_{29}Cu^{63.5}$) and aluminum ($_{13}Al^{27}$), are numerically evaluated by use of an IBM 7090 computer. Author

N65-15874# Ohio State U. Research Foundation, Columbus.
OBSERVATION OF THE λ ANOMALY IN SOLID D_2 BY NUCLEAR MAGNETIC RESONANCE
J. R. Gaines, E. M. de Castro, and D. White Oct. 1964 9 p refs
(Contract Nonr-495(20))
(TR-14; AD-608112)

Nuclear resonance studies of enriched para D_2 samples revealed the splitting of the resonance line in D_2 below 2° K. The preparation of the sample and experiment are described. The calculated value of the splitting (76.5 kc/sec) is in excellent agreement with the experimental value. After the splitting of the line occurred, several other effects were observed: the signal-to-noise ratio deteriorated rather badly, the line became so asymmetric that the recorder trace bore little resemblance to the conventional derivative curve, and the remnant central line became noticeably broader with a width of 5 to 8 gauss. R.E.S.

N65-15926# Los Alamos Scientific Lab., N. Mex.
STATUS REPORT ON OPACITY CALCULATIONS, SUPPLEMENT I
Walter F. Huebner and Robert S. Stuart (AF Weapons Lab., Kirtland AFB, N. Mex.) 14 Jan. 1965 73 p refs
(Contract W-7405-ENG-36)
(LAMS-3002, Suppl. I) OTS: $3.00

The results of a survey in the opacity field were compiled and are presented here, categorized according to the various phases of an opacity calculation. The categories considered include energy levels, wave functions, electronic occupation, bound–free transitions, free–free transitions, bound–bound transitions, scattering, molecular transitions, and complete opacity calculations. A list of scientists recently active in one or more of these fields is included. Author

N65-15943*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
MEASUREMENT OF THE EFFECTS OF FAST-NEUTRON RADIATION ON LIQUID ORTHO- AND PARA-HYDROGEN
James W. Blue and Theodore E. Fessler Washington, NASA, Feb. 1965 18 p refs
(NASA-TN-D-2591) OTS: HC $1.00/MF $0.50

A fast-neutron irradiation of both equilibrium and normal liquid hydrogen was performed and analyzed for evidence of conversion. The data indicated that radiation-induced ortho- to para-hydrogen conversion occurs in liquid normal hydrogen, but is less than 5×10^{-3} mole fraction for an integrated neutron flux of 5×10^{13} neutrons per square centimeter. A pronounced effect of irradiation was the destruction of superheat in the liquid-hydrogen bath surrounding the test samples. This effect caused a decrease in the temperature of the bath and thereby complicated the data analysis. Author

N65-15960*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
NEUTRON CROSS SECTIONS FOR TUNGSTEN ISOTOPES Topical Report
G. D. Joanou and C. A. Stevens 13 Nov. 1964 42 p refs
(Contract SNPC-27)
(NASA-CR-54261; GA-5885) OTS: HC $2.00/MF $0.50

A set of cross sections for the isotopes of tungsten, as well as for the natural element, is presented with extensive tabulation. Data are based upon experimental and nuclear model calculations. The cross sections believed to be of significance are those for capture, inelastic scattering, elastic scattering, and the n, 2n reaction. An analysis of each cross section is included. The results were incorporated into the library tapes of the GAM-II and GATHER-II computer programs. R.E.S.

N65-15975# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.

AUTOIONIZATION SPECTRA OF GASES OBSERVED IN THE VACUUM ULTRAVIOLET

Robert E. Huffman Nov. 1964 45 p refs *Its* Phys. Sci. Res. Papers No. 66

(AFCRL-64-911; AD-609849)

The spectra of metal vapors, such as the alkali and alkaline earths, and of the rare gases argon, krypton, and xenon are discussed. Recent measurements of the absorption coefficients (cross sections) of the rare gases argon, krypton, and xenon are discussed. Measurements were obtained down to 600 Å with a photoelectric scanning technique using a helium continuum background at a bandwidth of 0.5 Å. This bandwidth was sufficient to resolve the earlier members of the intense, diffuse, asymmetrical absorption line series originally found by Beutler between the $^2P_{3/2}$ ground state and the $^2P_{1/2}$ excited state of the ion. These measurements are discussed and compared with other recent theoretical and experimental investigations. Finally, a compilation of references to papers on autoionization spectra, arranged according to element and complete up to January 1964, is included. Author

N65-16053# Israel Inst. of Technology, Haifa.

FEYNMAN DIAGRAMS WITHOUT FIELD THEORY Scientific Report No. 12

A. Peres 24 Sep. 1964 6 p refs

(Grant AF-EOAR-64-20)

(ARL-65-27; AD-610142)

It is shown that the whole theory of the Feynman diagrams can be derived without using quantized fields, or creation and annihilation operators. Assumed is a normalized physical system that is symmetrized with respect to the permutations of particles of the formula:

$$a|O> + b_m|u_m> + c_{mn}|v_m\, w_n> + \ldots .$$

The operators having matrix elements between states with different numbers of particles are then introduced. The new expression corresponds to the sum of all possible Feynman diagrams and permits the derivation of the propagator values. G.G.

N65-16095# Ohio State U. Research Foundation, Columbus.

A SEARCH FOR ISOTOPIC PHASE SEPARATION IN H_2-D_2 MIXTURES

E. M. de Castro, D. Husa, J. R. Gaines, and J. G. Daunt Oct. 1964 10 p refs

(Contract Nonr-495(20))

(TR-13; AD-608111)

Nuclear magnetic resonance experiments were conducted to obtain data on the type of transition known as isotopic phase separation, i.e., a transition from the randomly mixed state (the high temperature equilibrium configuration) to the isotopically ordered state, involving a rearrangement of the isotopes into interpenetrating sublattices. The system H_2-D_2 was selected for study because observations of such a phase separation at the relatively high temperature of 16.4° K were reported. It was found that the NMR data in the H_2-D_2 mixtures can be adequately accounted for by extrapolation of the properties of the pure components. The composite resonance lines are characteristic of a hindered rotator, and no concrete evidence for isotopic phase separation was found. Although phase separation may be favored energetically below 4° K, the diffusion rates are so small that the time required to produce observable domains can be extremely long. D.S.G.

N65-16129 Michigan U., Ann Arbor. Coll. of Literature, Science, and the Arts

DIBOSON PRODUCTION BY PIONS OF 12 AND 18 GEV/C Technical Report No. 17

L. W. Jones, D. Harting, W. Middelkoop, B. Zacharov (CERN), D. O. Caldwell (Princeton U.) et al Sep. 1964 21 p refs

(Contract Nonr-1224(23))

(Rept.-03106-16-T; AD-608457)

A preliminary analysis of about 5000 events is presented. A spark chamber experiment was undertaken at the CERN proton synchrotron with an apparatus consisting of two two-meter bending magnets and eight spark chambers designed so that for each diboson event the incoming pion and each of two high-momentum outgoing bosons were momentum analyzed to about 1 percent. Chernakov counters discriminated between pions and kaons over a portion of the solid angle so that dikaons and K* systems could frequently be separated from dipions. An additional threshold Chernakov counter in the incoming beam permitted separation of incoming pions and kaons. Results of the experiments are given in tabulated form. R.E.S.

N65-16132# Space Technology Labs., Inc., Redondo Beach, Calif. Quantum Physics Lab.

ON THE QUANTUM FIELD THEORIES LEADING TO THE CORBEN EQUATIONS

Richard E. Norton Sep. 1964 46 p refs

(Contract Nonr-3769(00))

(STL-8665-6006-RU-000; AD-608355) OTS: $2.00

Formulations are presented for the second quantized versions of the field theories that lead to Corben's equations of motion. It is demonstrated that an indefinite metric is required to guarantee positive energies for all the particles, but that otherwise the theories are physically unambiguous. The number and properties of the resulting particles are studied, and compared with the conclusions from previous work. Alternative formulations are also discussed. Author

N65-16141# Oak Ridge National Lab., Tenn. Isotopes Development Center

EVIDENCE OF THE ABSENCE OF LONG-LIVED ISOTOPES OF PROMETHIUM FROM FISSION OF URANIUM, AND THE PURIFICATION OF PROMETHIUM FOR THE ESTABLISHMENT OF A PRIMARY SPECTROGRAPHIC STANDARD

P. B. Orr, R. S. Pressly, and E. J. Spitzer Jan. 1965 22 p refs

(Contract W-7405-ENG-26)

(ORNL-3631) OTS: $2.00

A sample of high-purity promethium, produced by uranium fission, was separated by ion exchange on Dowex 50 W-X4 hydrogen-form resin, with diethylenetriaminepentaacetic acid and citric acid as eluants. Within the limits of detection, no isotope of promethium with a half-life of greater than 2.6 yrs was found in the product which had decayed through two half-lives of ^{147}Pm. The promethium contained only traces of yttrium, samarium, and neodymium and was of sufficient purity to establish spectra for a promethium standard for use. Author

N65-16142# Oak Ridge National Lab., Tenn. Neutron Physics Div.
ELASTIC AND INELASTIC SCATTERING OF 8- TO 15-MeV DEUTERONS FROM ^{114}Cd: TABULATED DIFFERENTIAL CROSS SECTIONS
J. K. Dickens and F. G. Perey Jan. 1965 16 p refs
(Contract W-7405-ENG-26)
(ORNL-3727)

This report consists of a tabulation of numerical values of differential cross sections of deuterons that were elastically and inelastically scattered from ^{114}Cd. The cross sections were determined at 5° intervals between laboratory angles of 20° and 160° for incident energies of 7.96, 8.97, 9.97, 10.99, 12.0, 13.0, 14.0, and 15.0 MeV. The inelastic-scattering data are for deuterons that were inelastically scattered from the first excited state of ^{114}Cd (Q = −0.554 MeV). Author

N65-16174# General Dynamics Corp., San Diego, Calif. General Atomic Div.
EXPERIMENTAL STUDIES ON HEAVY ION EXCHANGE IN AIR Final Report, 17 Jun. 1963–30 Jun. 1964
W. L. Fite and R. F. Stebbings Kirtland AFB, N. Mex. AF Weapons Lab., Oct. 1964 45 p refs
(Contract AF 20(601)-6106)
(WL-TDR-64-89; AD-608271)

Charge-changing collisions between Al^+ ions and the gases Ar, N_2, O_2, and air were examined over the velocity range 0.25 to 1.9 × 10^8 cm sec^{-1}. Fast particle detection was used to obtain values for the electron capture cross section σ_{10}, and the ion stripping cross sections σ_{12} and σ_{13}. Higher ion stripping cross sections and capture cross sections to form negative ions of Al were negligible in comparison. In the lower velocity range (0.25 to 0.8 × 10^8 cm sec^{-1}), measurements of the total apparent ionization cross section of the target gas were made using slow particle detection. Estimates of the neutral Al stripping were made at the higher velocities, and these were found to be almost an order of magnitude higher then σ_{10}. Ion sources for Al^+ and other metallic ions are discussed together with general considerations pertaining to experiments using such ions. Author

N65-16202*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
NEUTRON CROSS SECTIONS FOR BERYLLIUM
G. D. Joanou and C. A. Stevens 13 Nov. 1964 33 p refs
(Contract SNPC-27)
(NASA-CR-54262; GA-5905)

A revised set of neutron cross sections was prepared for beryllium. These data were based upon existing experimental data. The compiled and evaluated data were incorporated into the GAM-II slowing down program and into the GATHER-II thermalization program. The literature survey associated with this report is complete to November 1964. Discussions are given of possible neutron reactions with beryllium, the total cross section, the nonelastic cross section, the n,α reaction, the n,2n reaction, the n,2n energy distributions, the n,t reaction, the phonon frequency spectrum of Be, the differential elastic scattering cross section, the n,γ reaction, and the n,p reaction. Tables are presented of measurements of the nonelastic cross section of measurements of the n,2n cross section, of neutron cross sections, of cross sections for the inelastic scattering from the 2.43 MeV level in Be and direct interaction with the 1.75 MeV level, of the lattice vibrational spectrum, and of the Legendre expansion coefficients for beryllium. D.E.W.

N65-16203*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
NEUTRON CROSS SECTIONS FOR U^{235}
G. D. Joanou and M. K. Drake 10 Dec. 1964 141 p refs
(Contract SNPC-27)
(NASA-CR-54263; GA-5944) OTS: HC $4.00/MF $1.00

The data for this revised set of neutron cross sections for U^{235} are based upon experimental data whenever possible. The compiled and evaluated data were incorporated into the GAM-II slowing down program and into the GATHER-II thermalization program. The literature survey is believed to be complete to November 1964. Other tables list the possible neutron reactions in the energy range 0.001 to 15.0 MeV, the results of several analyses of the most probable value of the 2200m/sec cross sections, sets of total cross section data available, sets of fission cross section measurements used in this evaluation, experimental values of α for U^{235} above 10 keV, Legendre expansion coefficients, the partial inelastic scattering cross sections, and a comparison of resonance integral data. R.L.K.

N65-16300# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
ATOMIC ABSORPTION CROSS SECTION OF LITHIUM VAPOR BETWEEN 2300 AND 1150 Å
R. D. Hudson and V. L. Carter 15 Jan. 1965 16 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-162; TDR-469(9260-01)-1; AD-455592)

The continuous atomic absorption cross section of lithium vapor was measured using photoelectric techniques from the $2s^2S \rightarrow np^2P^o$ series limit at 2300 to 1150 Å. The bandwidth of the monochromator was 0.75 Å, and values of the cross section were obtained at 2 Å intervals. The best value of the atomic absorption cross section at the series limit was 1.54± 0.23 mb. The shape of the curve near the series limit is in close agreement with some recent theoretical predictions. There is an apparent disagreement with recent experimental results. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-15428# Princeton U., N.J. Plasma Physics Lab.
MICROWAVE BREMSSTRAHLUNG FROM A FULLY IONIZED PLASMA
A. F. Kuckes and A. Y. Wong Oct. 1964 28 p refs
(Contract AT(30-1)-1238)
(MATT-308)

The microwave radiation from a fully ionized thermal plasma was observed as a function of magnetic confining field and plasma density. The plasma-generated radiation was found to be in quantitative agreement with a theory based on the high frequency resistivity computed by J. M. Dawson and C. R. Oberman in the range of plasma density $0.01 < \omega_p^2/\omega^2 < 0.1$ and magnetic field $0.7 < \omega_c/\omega < 1.25$ ($\omega/2\pi$ = 35 Gc/sec). Author

N65-15429# Princeton U., N.J. Plasma Physics Lab.
"UNIVERSAL" OVERSTABILITY OF A RESISTIVE INHOMOGENEOUS PLASMA

Francis F. Chen Nov. 1964 41 p refs
(Contract AT(30-1)-1238)
(MATT-311)

An inhomogeneous plasma with finite resistivity in a straight or curved magnetic field is subject to instabilities of electrostatic drift waves with small but finite $k_{\parallel}$. The influence on these instabilities of various factors such as finite β, resistive and viscous damping, and finite Larmor radius is investigated; and explicit, experimentally useful expressions for the frequency and growth rate are given. Author

N65-15430# Princeton U., N.J. Plasma Physics Lab.
REMARKS ON THE I-V CHARACTERISTIC OF A HIGHLY IONIZED SEMI-COLLISONLESS CESIUM PLASMA
N. D'Angelo Nov. 1964 17 p refs
(Contract AT(30-1)-1238)
(MATT-312)

Similar current–voltage curves were obtained for a highly ionized cesium plasma which was confined radially by a magnetic field and where no magnetic field was present. The plasma density was measured and found to be a decreasing function of the applied voltage. An analysis of a cesium plasma that was contained between two hot parallel and infinite tantalum plates without a magnetic field was performed. The ion and electron current densities were obtained by equations from the ion and electron distribution functions. It was found that only a density drop of 15% occurs when the heating of the ions is not considered in the main distribution. The heating of the ions by the current, and also the enhancement of ion losses at the end plates by the ion sound waves can be possible causes of the density loss. G.G.

N65-15431# Princeton U., N.J. Plasma Physics Lab.
PLASMA LOSSES IN A Q-DEVICE
N. D'Angelo and S. V. Goeler Dec. 1964 27 p refs
(Contract AT(30-1)-1238)
(MATT-314)

Probe and microwave measurements are presented, which support the view that the ordinary plasma of a Q-device is suitably described by the equilibrium model. An apparent discrepancy between Motley's results, giving considerable support to the equilibrium model, and those of Grieger, appears to be resolved by consideration of probe losses. Author

N65-15548*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERIMENTAL INVESTIGATION OF ELECTRIC DRAG ON SPHERICAL SATELLITE MODELS
William C. Pitts and Earl D. Knechtel Washington, NASA, Feb. 1965 41 p refs
(NASA-TN-D-2619) OTS: HC $2.00/MD $0.50

Electric drag is defined as the difference between the drag of a charged satellite and the drag of an identical satellite with no charge. The drag increment is a consequence of the effective increase in size of the satellite resulting from scattering of ambient ions by the satellite potential. Experimental results, wherein electric drag was measured on conducting spheres in a streaming mercury plasma, have shown that electric drag can be a significant portion of the total drag if the fraction ionization is sufficiently high. To properly estimate electric drag of satellites it is necessary to account both for the ion surface collision and for the shielding effect of the ion sheath around the satellite surface. These conditions are most nearly fulfilled by the theory of Jastrow and Pearse. Using this theory and the test conditions of this investigation, the drag of 1.9 and 2.5-cm-diam spheres is predicted to within 10% of the experimental results. Scaling parameters developed allow the relation of the present experimental results to satellite conditions. The scaling parameters and an existing simple ion sheath theory are used as guides in developing an approximate equation that estimates electric drag to reasonable accuracy over scaling parameter ranges of practical interest. Author

N65-15552# General Electric Co., Philadelphia, Pa.
ELECTRIC ARCS IN TURBULENT FLOWS Interim Report, Mar. 1963–Apr. 1964
Gerhard Frind Wright-Patterson AFB, Ohio, ARL, Sep. 1964 38 p refs
(Contract AF 33(657)-8206)
(ARL-64-148; AD-608938)

Experiments were conducted to find the characteristic differences between electrical arcs in laminar and turbulent flows. To start with the simplest conditions, an attempt was made to burn arcs in the fully developed flow region of a flow tube. Measurements of the electrical potential along the flow tube showed that the electrical gradient reaches asymptotically constant values at the end of the flow tube, even for flow velocities as high as 250 m/sec. At these velocities, the gradient is about twice as large as compared to gradients for arcs with speeds smaller than 20 m/sec. High-speed photography with exposure times of 2 μsec revealed that the low-velocity arcs are in a quiet, apparently laminar mode, whereas the high-velocity arcs are moving violently and with apparent randomness. The flow velocity of the high-speed arcs still increased considerably at the end of the flow tube. This suggests that still larger l/d values must be used to reach fully developed flow. Author

N65-15606# Princeton U., N.J. Plasma Physics Lab.
ON THE EXPLOSION OF A SUPERNOVA INTO THE INTERSTELLAR MAGNETIC FIELD, PART I
I. B. Bernstein and R. M. Kulsrud Sep. 1964 32 p
(Contract AT(30-1)-1238)
(MATT-295)

The problem of the earlier stages of the explosion of a supernova into the interstellar magnetic field is idealized by the model of the uniform expansion from a point of a perfectly conducting piston into an ideal magnetohydrodynamic fluid immersed in a constant magnetic field. The resulting similarity solution is determined in the limit where the magnetic pressure is much greater than the material pressure, and where the piston speed is much less than the Alfven speed. Author

N65-15637# Princeton U., N.J. Plasma Physics Lab.
SCATTERING OF ELECTROMAGNETIC WAVES FROM "MARGINALLY STABLE" PLASMA WAVES
V. Arunasalam Dec. 1964 9 p refs
(Contract AF(30-1)-1238)
(MATT-317)

From the results of previously reported studies, the electron velocity distribution function of a beam-plasma, and the scattering cross section as a function of the frequency of the marginally stable acoustic plasma waves, were determined. It was shown that the cross sections for the scattering of electromagnetic waves from density fluctuations associated with marginally stable plasma waves are very much larger than the Thomson cross section. With this large enhancement of the scattering cross section, microwave scattering experiments on marginally stable plasma waves of a laboratory beam-plasma system are possible. D.S.G.

N65-15642# MHD Research, Inc., Newport Beach, Calif.
EXPLOSIVE MAGNETOHYDRODYNAMICS Second Quarterly Technical Progress Report, 1 Jul.–30 Sep. 1964
Malcolm S. Jones, Jr., Francis H. Webb, Jr., Paul Webster, Sydney Handlin, David Komaroff et al 14 Oct. 1964 73 p refs
(Contract AF 33(615)-1594)
(MHD-660; AD-607518)

Experimental and theoretical studies of explosive driven MHD generators are reported. Experimental studies in a 1 × 4 inch linear channel have covered explosive charge geometry effects, various seed materials, plasma conductance, and a determination of the plasma inductance. A radial explosive driven MHD generator experiment is described, and theoretical relations are developed. Author

N65-15660# Brown U., Providence, R.I. Engineering Div.
WAVEGUIDE ANALOGIES OF SCATTERING AND PROPAGATION IN INHOMOGENEOUS PLASMA
Lewis Wetzel and Leonard G. Cohen Jul. 1964 33 p refs
(Contract Nonr(562)-35; AF 19(628)-2498)
(Nonr(562)35/4; AD-606981)

The conditions are found under which dominant mode propagation in a lossless tapered waveguide may serve as an analogue of plane-wave propagation in a lossless inhomogeneous plasma. These conditions are relatively mild, thereby permitting a suitably tapered waveguide to be used as an analogue computer for the determination of both field distributions and the reflection and transmission coefficients for plasma distributions having fairly arbitrary density profiles. The analogy is demonstrated by an experimental determination of the reflection coefficient for a linear plasma profile. Analogies based on the use of an inhomogeneous dielectric in a uniform waveguide are discussed briefly. It is found that such analogies are suitable for measurements only at a single frequency and are therefore of limited practical utility. Author

N65-15662# Stanford U., Calif. Microwave Lab.
NUMERICAL CALCULATIONS RELATED TO THE RF PROPERTIES OF THE PLASMA SHEATH
J. M. Pavkovich Oct. 1963 183 p refs
(Contract AF 33(616)-8121)
(ML-1093; AD-431854)

In many considerations of the rf properties of a finite plasma, the plasma is treated as a dielectric with a dielectric constant of $K = 1 - \omega_p^2/\omega^2$, and the boundary conditions associated with an ordinary dielectric are applied. As a more satisfactory approach to understanding the rf properties of the boundary, a detailed rf theory of the sheath is presented. The complete collisionless Boltzmann equation is used to derive a linear integral equation for the rf electric field through the sheath. The analysis is one-dimensional. This integral equation is solved numerically for a semi-infinite uniform plasma bounded by a sheath defined by a parabolic dc potential. A Maxwellian distribution of velocities is assumed for all computations. The results show it is reasonable to assume that the normal component of displacement is continuous but that extra waves are set up near the boundary which decay with movement into the uniform plasma, and which give rise to a sheath impedance. Author

N65-15729# AVCO-Everett Research Lab., Everett, Mass.
LINEAR THEORY OF AN MHD OSCILLATOR
James E. Mc Cune Dec. 1964 39 p refs
(AVCO-Everett Res. Rept.-198; AD-609165)

The linear theory of ac fluctuations in an MHD channel subject to the Hall instability of Velikhov is explored. It is shown that the system as a whole (plasma, plus boundaries, plus external circuitry) is stable to the Velikhov mode, except at certain resonant acoustic frequencies. If these resonant frequencies are excited, channels of sufficient size can be made to oscillate and produce net ac power. However, nonlinear effects limit the ac power level severely for this geometry, and adversely affect the dc performance of the channel. The analysis shows that resonant fluctuations can be controlled by external circuitry. Author

N65-15736*# Consultants and Designers, Inc., Arlington, Va.
ON THE HEATING OF ELECTRONS IN AN ANISOTROPIC PLASMA [K VOPROSU O NAGREVE ELEKTRONOV V ANIZOTROPNOY PLAZME]
V. I. Pistunovich and A. V. Timofeyev 28 Jan. 1965 7 p refs
Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Fiz. (Moscow), v. 159, no. 4, 1964 p 779–781
(Contract NAS5-3760)
(NASA-TT-F-9634; ST-PP-10284) OTS: HC $1.00/MF $0.50

A low-pressure plasma with anisotropic distribution of ions by velocities, may be unstable relative to onset of potential oscillations. Thus, for example, a cyclotron instability of strongly anisotropic collisionless plasma is considered in the intermediate region of phase velocities. It is demonstrated, that this instability on the branch of oscillations has negative energy, i.e.,

$$W = \frac{1}{8\pi}\frac{d}{d\omega}(\epsilon\omega)|E|^2 < 0; \text{ where } \epsilon = \epsilon_{pq}\frac{\kappa_p\kappa_q}{k^2}$$

is the longitudinal plasma dielectric constant: at the same time its development must be attended by intense energy absorption by resonance electrons (Landau damping). That is why it is possible that the anomalous heating of electrons that is observed in adiabatic traps is caused by the development of this instability. Author

N65-15772# California U., Berkeley, Electronics Research Lab.
SYNCHROTRON RADIATION MEASUREMENTS FROM A HOT ELECTRON PLASMA
A. J. Lichtenberg, S. Sesnic, and A. W. Trivelpiece 17 Aug. 1964 39 p refs
(Grants NSF GP-2239; AF-AFOSR-139-64; Contract AF 33(615)-1078)
(Rept.-64-28; AD-454768)

The synchroton radiation emanating from a hot-electron plasma produced in a pulsed magnetic mirror field was measured. The measurements were made with a 1μsec time constant InSb detector with a frequency response covering the wavelengths between 4 mm and 0.1 mm. For peak fields that were varied between 30 and 60 kG with corresponding electron temperatures between 26 and 50 keV, the radiation was found to be greater than 0.1 mW/sr at the low field and greater than 1.0 mW/sr at the high field. This variation was consistent with that calculated by integrating the radiation from a single electron over a two dimensional, relativistic Maxwellian with the appropriate temperature. Preliminary results on the spectral distribution of the radiation were obtained. The decay of the radiated power is closely correlated with microwave radiation and other diagnostics both in regimes in which the plasma was stable and in those in which the plasma developed an instability. The spectral distribution of the radiation was measured and agrees with the theory of Trubnikov. An independent time resolved temperature was calculated from these measurements which is in good agreement with that obtained from X-ray pulse height analysis. Author

N65-15794# Brown U., Providence, R.I. Div. of Engineering
A.C. SOLENOID OF FINITE LENGTH IN A CONDUCTING MEDIUM WITH HALL CONDUCTIVITY
Suha Selamoglu and Paul F. Maeder Jun. 1964 85 p refs
(Contract AF 49(638)-1295)
(WT-40; AFOSR-64-2028; AD-609462)

The electric field due to an alternating current carrying solenoid was investigated by the field approach. The solenoid was assumed to be in an infinite, uniform, conducting medium, which may exhibit the Hall effect caused by a constant, axial, external magnetic field. Both the infinite and finite coil problems were studied. Explicit solutions to the infinite coil were found, while the finite coil solutions were obtained in integral form. From the latter, the coil impedance and the voltage induced in a particular wire loop were calculated numerically for different scalar and Hall conductivities at different length-to-diameter ratios. Some experimental evidence for the calculated values of the impedance without the Hall effect also was found. Author

N65-15807# Massachusetts Inst. of Tech., Cambridge.
STUDY OF PLANE SHOCKS AND HIGH SPEED PLASMA IN MAGNETIC FIELDS Final Report, 1 Oct. 1961–30 Sep. 1964
J. A. Fay and W. C. Moffatt 30 Sep. 1964 15 p refs
(Contract AF 19(628)-221)
(AFCRL-64-906; AD-454061)

This report describes a theoretical and experimental investigation of the behavior of plane shock waves in magnetic fields, the interdiffusion of plasmas and magnetic fields, and the phenomenon of turbulence in plasmas with applied fields. Brief descriptions of seven separate investigations that were undertaken in these areas are presented, and in each case reference is made to the appropriate publication from which additional information may be obtained. Author

N65-15889*# Consultants and Designers, Inc., Arlington, Va.
CURRENT VORTICES AND CRITICAL SURFACES IN A MAGNETOHYDRODYNAMIC FLOW [TOKOVYYE VIKHRI I KRITICHESKIYE POVERKHNOSTI V MAGNITOGIDRODINAMICHESKOM POTOKE]
L. M. Alekseyeva and L. S. Solov'yev 30 Jan. 1965 15 p refs
Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 28, no. 6 p 987-995
(Contract NAS5-3760)
(NASA-TT-F-9631; ST-MHD-PP-10281) OTS: HC $1.00/MF $0.50

A stationary, axially symmetric flow of an ideally conducting plasma across an azimuthal magnetic field is considered in this work. Investigated also is the possibility of appearance of singular points, of elliptic and hyperbolic types, belonging to the family of current lines $rH_\phi = const$. The shape of critical surfaces, at which the flow velocity v reaches the signal propagation velocity $c_s = \sqrt{c^2 + H_\phi^2/4\pi\rho}$ is computed. The steadiness of such flows is discussed. Author

N65-15966# Purdue Research Foundation, Lafayette, Ind.
INVESTIGATION OF ENERGY TRANSFER IN A TUBE ARC HEATER
James Gary Skifstad (Ph.D. Thesis) Wright-Patterson AFB, Ohio, ARL, Jul. 1964 112 p refs
(Contract AF 33(657)-10933)
(ARL-64-112; AD-610147)

Experimental data are presented for a tube, 3/8 in. in diameter, wherein helium gas is heated to bulk stagnation enthalpies above 20 000 B/lb. The data include the axial distributions of the heat flux to the tube wall, the potential distribution along the arc, the total voltage and current of the arc, and the distributions of the properties of the jet measured by means of a probe. An analysis of the flow and energy transport phenomena, based on the recent methods of laminar flow theory, is presented. The methods yield a system of simultaneous ordinary differential equations describing the flow field. Numerical computations are included. Author

N65-15968# Dartmouth Coll., Hanover, N.H.
ON COOLED ANODES IN CONTACT WITH LAMINAR ARC-HEATED FLOWS Interim Technical Report, 1 Feb. 1962–1 Aug. 1963
Harris B. Mc Kee, Robert C. Dean, Jr., and Agnar Pytte Wright-Patterson AFB, Ohio, ARL, Oct. 1964 82 p refs
(Contract AF 33(657)-8179)
(ARL-64-178; AD-609910)

This study is concerned with the physics and operating characteristics of cooled anodes in contact with an arc-heated laminar plasma flow in a constant area duct. Various modes of anode behavior are identified and described. Some influences of gas type, flow rate, arc current, anode material, and geometry are demonstrated. A theory is developed to explain the low-current mode of the anode characteristics. It is shown that the local current density on the anode surface is related approximately to the surface's local bias, relative to its electrically floating voltage. Anode current distribution data are presented; the distribution is shown to be unstable above a transition bias voltage, with the current concentrating intensely on the edge of the anode toward the cathode. Author

N65-15969# Yale U. Observatory, New Haven, Conn.
BASIC EQUATIONS OF THE RELATIVISTIC TEST PARTICLE PROBLEM Interim Technical Report
S. P. S. Anand Wright-Patterson AFB, Ohio, ARL, Oct. 1964 15 p refs
(Contract AF 33(657)-7271)
(ARL-64-187; AD-609590)

From a completely covariant formulation, the general equations that describe density and velocity distribution, as well as the electromagnetic field induced by a charged particle in the surrounding fluid, are derived. Linearization is introduced as usual, but the possibility of an external magnetic field is excluded. It is shown that it is of little importance whether the test particle is relativistic or not, as long as the ensemble's mean thermal speed is small compared with the speed of light. Author

N65-15970# General Electric Co. Philadelphia, Pa. Engineering Research Section
AN UNCOOLED, RAPID RESPONSE PROBE FOR MEASURING STAGNATION PRESSURES IN HIGH VELOCITY ARC PLASMA Interim Technical Report, Mar. 1963–Apr. 1964
P. Barkan and A. M. Whitman Wright-Patterson AFB, Ohio, ARL, Nov. 1964 55 p refs
(Contract AF 33(657)-8206S1)
(ARL-64-192; AD-609621)

This report describes a means for measuring stagnation pressures in high temperature, high current plasmas. The device employs a small (<.060 in. o.d.) uncooled pitot tube designed for minimum response time (<.001 sec.) which is rapidly swept through the plasma field (<.015 sec.). A simple technique for evaluating the transient response of the

probe is described. Because the probe tip is inexpensive and expendable, a moderate amount of molten phase ablation is tolerable in the stagnation zone. Consequently, it appears possible to obtain meaningful results at heat flux rates exceeding 10^4 cal/cm^2 sec., which is one to two orders of magnitude greater than have thus far been tolerable with watercooled probes. In preliminary tests, a single probe was successfully employed for eight successive measurements of total pressure in an atmospheric pressure, air-arc plasma at currents ranging from 200 to 1000 amperes at Mach numbers close to unity. Heat flux rates encountered are estimated to be in the vicinity of 2000–3000 cal/cm^2 sec. The principle merits of the probe described are its small size, rapid response and its inexpensive, expendable probe tip. Author

N65-15978# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center
FLUOROCARBON GASES Data Sheets
John T. Milek Nov. 1964 134 p refs
(Contract AF 33(615)-1235)
(EPIC-DS-142; AD-608897)

A complilation of the electrical properties of various halocarbon or halogenated hydrocarbons known as Freons, Genetrons, Arctons, etc. is presented. A master identificaton chart relating the trade names and numbers to the chemical names is included for easy reference. Detailed electrical properties include corona effects, dielectric constant, dielectric strength, and dissipation factor. Each property is compiled over the widest possible range of pressure, temperature, electrode geometry effects, and types of electrodes from references obtained in a thorough literature search. Physical and chemical property data are also included, as well as electrical and electronic applications. Author

N65-15998# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
ANALYSIS OF ELECTRON BEAM-PLASMA SYSTEMS
Philip E. Serafim 31 Jul. 1964 99 p refs
(Contract DA-36-039-AMC-03200(E); Grants DA-SIG-36-039-61-G14; NSF G-24073)
(TR-423; AD-609023)

An exact analysis is made of the beam-plasma waveguide, based on the linearized Maxwell equations and the Lorentz force equation. The "operator" dielectric tensor description of the beam-plasma medium is introduced. The properties of this tensor are examined, and the boundary conditions are formulated in terms of the elements of this tensor. The field analysis for the beam-plasma system is made, and the dispersion equation and the determinantal equations are derived from the satisfaction of the boundary conditions. Cutoffs, resonances, slow waves, and the quasi-static approximation are studied. Conservation principles for the specific beam-plasma system are formulated, and Chorney's bidirectional theorem is extended to the medium. A solution of the plasma waveguide problem by a coupling-of-modes theory is given. The theory of coupling of empty-waveguide modes and quasi-static modes for the approximate description of a general gyrotropic medium is formulated. The results are specialized for plasma waveguides, and the case of a completely filled circular plasma waveguide is examined in detail. Author

N65-16011# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
LF, VLF, ELF PROPAGATION STUDIES: AUDIO AND SUB-AUDIO FREQUENCY EM WAVES PROPAGATED FROM SPHERICAL PLASMA SOURCES EXCITED BY ACOUSTIC PERTURBATIONS Annual Report, 3 Aug. 1963–3 Aug. 1964
J. Ralph Johler Griffiss AFB, N.Y., RADC, Nov. 1964 55 p refs
(Contract AF 30(602)-2488)
(RADC-TDR-64-425; AD-610033)

An oscillating ionized plasma of finite size can be shown theoretically to be a new type of transmitter of EM-waves. Acoustic waves traveling through the plasma are postulated as a source of excitation of the EM-waves propagated from the plasma. The antenna pattern of the spherical plasma source of EM-wave, energized by such acoustic waves, can be quantitatively described. Author

N65-16036# American Science and Engineering, Inc., Cambridge, Mass.
A CONJECTURE ABOUT THE STRUCTURE OF A MAGNETIC SHOCK WAVE IN A PLASMA Final Report, Part III
Yvain M. Treve 1 Jul. 1964 41 p refs
(Contract AF 19(628)-2388)
(ASE-654; AFCRL-64-594(III); AD-609942)

A model is considered for the structure of a plane, steady shock wave propagating in an inviscid plasma across a magnetic field normal to the direction of propagation. The model does not possess a solution for relatively small magnetic fields. Assuming that a continuous solution exists in this case when the effects of viscosity are taken into account, it is shown how the occurrence of a subshock can be conjectured when these effects become vanishingly small. Author

N65-16065# Maryland U., College Park.
MEASUREMENT OF THE OSCILLLATOR STRENGTH OF THE NEUTRAL HELIUM RESONANCE LINE Scientific Report No. 3
Reimer Lincke (Ph.D Thesis) 24 Nov. 1964 161 p
(Contract AF 19(628)-269)
(AFCRL-64-960; AD-609998)

The f-value of the λ 584 HeI line was determined from the saturated emission profile, using an electromagnetic T-tube filled with a hydrogen–helium mixture as light source. Since the central saturation levels of this line and the higher series members could be connected by a smooth curve which (with a small correction for detector response) agreed with the relative blackbody intensity, these levels were identified with the blackbody corresponding to the measured plasma temperature, and this furnished the required calibration standard. The electron density was obtained from the half-width of λ3889 HeI and the temperature from the relative intensities of visible hydrogen and helium lines. Deducing the ground state density of neutral helium from LTE relations, the oscillator strength then followed from the best fitting theoretical Stark profile. The resulting value f = 0.27 ±0.07 is consistent with most recent theoretical values. Author

N65-16070# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN APPARATUS FOR OBTAINING PLASMA AND STUDYING ITS PROPERTIES
A. Ye. Sheyndlin, E. I. Asinovskiy et al 14 Oct. 1964 11 p refs Transl. into ENGLISH from Nauchno-Issled. Inst. Vysokikh Temperatur (Moscow), 1963 5 p
(FTD-TT-64-812/1+2; AD-608045)

Described is an electric arc stabilized by means of cooled copper walls. Considered are some characteristics of an arc in the presence of activity on argon, including evidence that with currents of the order of 50 to 60 A, temperatures on the axis of discharge reach 11 000° – 12 000° K. Author

N65-16125# Naval Research Lab., Washington, D.C. Analysis and Theory Branch
RIGOROUS TREATMENT OF THE PROPAGATION AND DAMPING OF SMALL-AMPLITUDE PLASMA WAVES IN AN INITIALLY MAXWELLIAN PLASMA
A. W. Saenz 28 Aug. 1964 22 p refs
(NRL-6125; AD-607397) OTS: $0.50

A mathematically rigorous investigation is made of the dispersion relation for small amplitude plasma oscillations of definite wave-number vector that are excited in an initially Maxwellian plasma. The dimensionless quantity $\alpha = (r_D k)^2$ here is a small positive number, r_D being the pertinent D length and k the magnitude of the wave-number vector of the plasma oscillation of interest. More precisely, discussed is in the limit $\alpha \to +0$ the so-called Landau denominator or plasma dispersion function $\Delta(z) = 1 + \alpha - \pi^{1/2} z\, e^{z^2}$ erfc (z) corresponding to such a plasma. In this limit $\Delta(z)$ has exactly two zeros (complex conjugates of one another) in the half-plane Re $z < 0$ that lie closer to the imaginary z-axis than all the other zeros of $\Delta(z)$ in this half-plane. Also established are rigorous asymptotic formulas for the real and imaginary parts of these two nearest zeros for $\alpha \to +0$. Author

N65-16130# Stanford U., Calif. Microwave Lab.
HARMONIC GENERATION IN PLASMAS
J. H. Krenz Jul. 1963 152 p refs
(Contract Nonr-225(48)
(ML-1055; AD-420932)

The generation of harmonics due to the nonlinear properties of a microwave plasma discharge is investigated theoretically and experimentally. The nonlinear effects of collisions, spatial variations of rf electric field and plasma density, and sheaths are analyzed. The reactive nature of spatial variations is shown to result in particularly strong harmonics. Harmonic currents result from both a nonuniform rf electric field and a nonuniform plasma density. A static magnetic field perpendicular to the rf electric field is also included to investigate the effect of cyclotron resonance at either the fundamental or second harmonic frequency. While a resonance in second harmonic power is possible if the fundamental rf electric field is held constant, no resonance is obtained if the input power is held fixed. Harmonics higher than the second are found to depend very strongly upon the plasma sheath region. Author

N65-16146# Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
PLASMAS IN CUSPED MAGNETIC FIELDS AND SIMILAR GEOMETRIES Annotated Bibliography
E. J. Blau Aug. 1964 50 p refs
(Contract NOw-62-0604-c)
(TG-230-B4; AD-451426)

An attempt is made to include all articles and reports pertinent to the field of cusped geometry in the area of thermonuclear fusion processes. The bibliography contains a short abstract of all articles cited. R.E.S.

N65-16180 Princeton U., N.J. Plasma Physics Lab.
EXCITATION OF DRIFT INSTABILITIES IN THERMIONIC PLASMAS
Francis F. Chen Dec. 1964 42 p refs
(Contract AT(30-1)-1238)
(MATT-313)

Low frequency oscillations traveling near the electron pressure-gradient drift velocity in Cs or K plasmas were observed to exist only in the presence of an ion sheath at the cathodes. It is suggested that these waves are self-exciting universal instabilities in the presence of finite resistivity and that their excitation is connected with the insulating properties of an ion sheath, which allow the perturbation amplitude to be finite at the sheath edge. This leads to overstable oscillations with $\lambda_{||}$ longer than the length of the machine, a strange concept that is explained physically. Although the solution of the problem involves sheath-type boundary conditions, for an isothermal plasma the criterion for onset of instability can be stated rather simply. The predicted critical sheath voltage agrees well with observations. It appears that alkali-metal plasmas with electron sheaths are quiescent only by virtue of stabilization by conducting end plates; however, this feature makes such plasmas particularly valuable for the study of the onset of long-wavelength drift instabilities. Author

N65-16184# Compagnie Francaise Thomson–Houston, Paris (France). Div. Tubes Electroniques
PROPERTIES OF EMITTERS AND COLLECTORS FOR THERMIONIC CONVERTORS [PROPRIETES DES EMITTEURS ET COLLECTEURS POUR CONVERTISSEURS THERMOIONIQUES]
J. E. Picouendar and O. Cahen 17 Mar. 1964 16 p In FRENCH
Presented at the 6th AGARD Combust. and Propulsion Colloq., Cannes, France, 16–20 Mar. 1964

The work described demonstrates that it is possible to use a thermionic converter functioning at base temperature. The exact understanding of the encountered phenomena depends on three problems: (1) the role of different parts of the converter; (2) evaporation of cesium on the collector; and (3) the behavior of the partially ionized plasma. As opposed to procedures and measurements previously accomplished, the thermionic converters seem actually to function at base temperatures. The theoretical experiments, which have been conducted, permit a great distance between the electrodes. Their performance gives promise of improvement. The energy used is competitive because of the reasonable temperatures required. Trans. by R.E.S.

N65-16192# Purdue U., Lafayette, Ind.
THERMODYNAMICS OF MHD ENERGY CONVERSION
Harold M. de Groff and Richard F. Hoglund [1964] 77 p refs
Presented at the 6th AGARD Combust. and Propulsion Colloq., Energy Sources and Energy Conversion, Cannes, France, 16–20 Mar. 1964

Both open and closed-cycle linear magnetohydrodynamic generators are discussed. The recent progress made in open-cycle generators, with combustion reactions serving as the heat source, is described. Closed-cycle MHD power generators appear to have their most immediate application coupled with a nuclear reactor heat source in a spacecraft power system. Here the key advantages of MHD power generation are compactness, absence of moving parts, high power output and high heat rejection temperature (which tends to minimize radiator area). These advantages are related to the thermodynamics of the generator. In the case of closed-cycle generators, successful operation depends upon the achievement of adequate electrical

conductivity at relatively low temperatures. The most promising approach is through nonequilibrium ionization. The thermodynamic energy exchange processes which govern the extent of nonequilibrium ionization are discussed. Future prospects of development and key research areas pertinent to closed-cycle MHD power generation are described. Author

N65-16200# Birmingham U. (Gt. Brit.)
IONIC REACTIONS IN THE IONOSPHERIC GASES First Annual Summary, 8 Jan. 1963–9 Jan. 1964
M. J. Copsey and D. Smith Sep. 1964 13 p refs
(Grant AF-EOAR-63-74)
(AFCRL-64-892; AD-608495)

This work is concerned with the measurement of the decay constants of the atomic ions He^+ Ne^+ and Ar^+ in their pure parent gases by monitoring the density of these species as a function of time in an afterglow, using a time-resolving mass spectrometer, and the decay of electron density in these pure gases using a Langmuir probe. Author

N65-16282# Microwave Associates, Inc., Burlington, Mass.
INVESTIGATION OF HIGH POWER GASEOUS ELECTRONICS Eighth Quarterly Progress Report, 16 Aug.–15 Nov. 1964
H. S. Maddix and J. Gregory [1964] 39 p refs
(Contract DA-36-039-AMC-00097(E))
(Rept.-8; AD-455347)

A mass spectrometer was used to analyze sorption and desorption in a microwave discharge. Desorption spectra for argon and hydrogen at copper and molybdenum surfaces following gas cleanup were obtained with the mass spectrometer. The sorption rate of hydrogen in molybdenum at 25° C has been observed to be greater than in copper at 25° C. At 325° C the rates are nearly equal. Previously reported high sorption rates of argon in copper have not been reproduced. Present observations indicate that argon exhibits a cleanup rate in molybdenum that is much lower than argon in copper. An investigation of the effects of variable pulse repetition rates shows that cleanup increases rapidly at low rates and levels off at high rates. This behavior is explained by a theory based on the relationship between sticking time and interpulse period. Author

N65-16288# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORETICAL PRINCIPLES OF THE MHD GENERATOR
Zdzislaw Celinski 23 Dec. 1964 19 p refs Transl. into ENGLISH from Przegl. Elektron. (Poland), v. 37, no. 9, 1961 p 353–358
(FTD-TT-64-103-1+2; AD-455508)

In presenting a simplified theory of magnetohydrodynamic (MHD) generators, the basic elements of the unit were listed, along with a compilation of designations. General equations were given for combining the thermodynamic parameters of the generator. Basic equations of the MHD generator were presented—continuum equation, equations of forces, power, gas, enthalpy, mass force, field intensity, and current density—and methods for reducing these by substituting magnitudes were given. Expressions are derived for cases of constant speed, section, and pressure in MHD generators. M.G.J.

N65-16311*# Consultants and Designers, Inc., Arlington, Va.
A DISCRETE MODEL OF MATTER IN THE PROBLEM OF RAREFIED PLASMA FLOWING PAST SOLIDS [DISKRETNAYA MODEL' VESHCHESTVA V ZADACHE OBTEKANIYA TEL RAZREZHENNOY PLAZMOY]
M. V. Maslennikov and Yu. S. Sigov 10 Feb. 1965 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Matem. Fiz. (Moscow), v. 159, no. 5, 1964 p 1013–1016
(Contract NAS5-3760)
(NASA-TT-F-9640; ST-PP-10291) OTS: HC $1.00/MF $0.50

An axisymmetric body A is placed in a stationary flow of rarefied plasma, neutral at infinity, and moving parallel to the axis of A with a macroscopic velocity v. A self-consistent electrostatic potential $\phi(r)$, settling in the vicinity of A, is sought. The $\phi(r)$ depends on the characteristics of the incident plasma flow, on the dimensions and shape of A, and on the potential $\phi_\Sigma(r)$ assigned at its surface Σ. It is assumed that the ion striking Σ is absorbed, and that there are no ions in the vicinity of A that move over finite trajectories. It is assumed that the spatial electron density is determined by the definition of the self-consistent potential at the same point. The motion of the ion component is described with the aid of the Vlasov collisionless kinetic equation. This problem is considered in cylindrical coordinates (r,z), and is resolved by the method of consecutive approximations or iterations by ion fluxes. D.E.W.

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-15506 Pennsylvania U., Philadelphia.
EXCITONS AND TWO QUANTA PROCESSES IN MOLECULAR CRYSTALS
Robin M. Hochstrasser *In* Gen. Telephone and Electron. Labs. Conf. on Org. Lasers 25 May 1964 p 58–71 refs (See N65-15502 06-16)

The photoprocesses that occur in isolated molecules are compared with the analog processes usually assumed to occur in molecular crystals of some purity. Experimental approaches investigating the pathways of excitation energy in molecular crystals are described. R.L.K.

N65-15507 California Inst. of Tech., Pasadena.
STIMULATED EMISSION IN ISOTOPICALLY MIXED BENZENE CRYSTALS
D. S. Tinti and G. W. Robinson *In* Gen. Telephone and Electron. Labs. Conf. on Org. Lasers 25 May 1964 p 72–90 (See N65-15502 06-16)

A dominant stimulated emission process appeared to be achieved experimentally for 1% by weight perprotonated benzene (C_6H_6) in perdeuterated benzene (C_6D_6), with a population inversion between the levels and a sufficiently large radiation density at the frequency separation of the levels. As the electrical input energy to the flash lamp was increased, the intensity of phosphorescence (radiative $2 \rightarrow 1$ process) abruptly diminished, and the intensity of the fluorescence (radiative $3 \rightarrow 1$ process) increased. If substantial stimulated emission were occurring with increasing radiation density, such an effect would be expected. Other explanations than stimulated emission for the disappearance of the phosphorescence are: (1) absorption from the $^3B_{1u}$ of C_6H_6 to some higher lying state; (2) heating of the

crystal; and (3) triplet-triplet annihilation. Evidence against these alternatives is presented. R.L.K.

N65-15517# Massachusetts Inst. of Tech., Cambridge.
SOLID-STATE AND MOLECULAR THEORY GROUP Quarterly Progress Report
J. C. Slater, P. D. De Cicco, P. M. Scop, and L. Gunther 15 Oct. 1964 92 p refs
(Contracts Nonr-1841(34); AF 19(628)-356; Grants NSF G-10821; NSF G-24908; NSF GP-3241)
(QPR-54; AD-607917)

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N65-15518 Massachusetts Inst. of Tech., Cambridge.
EMPIRICAL ATOMIC RADII AND SELF-CONSISTENT FIELDS
J. C. Slater *In its* Solid-State and Mol. Theory Group 15 Oct. 1964 p 4–8 (See N65-15517 06-26)

A comparison is made of empirical atomic radii with radii of maximum radial charge density in the outermost shells in atoms, as calculated by the Dirac–Slater method, and excellent agreement is shown. The empirically determined radii were found entirely from the crystal-structure data before the calculations were made. The only significant disagreement is shown for the elements mercury to polonium. This is explained by the erratic behavior of these elements in their crystal structure. D.S.G.

N65-15519 Massachusetts Inst. of Tech., Cambridge.
VALIDITY OF THE "MUFFIN TIN" APPROXIMATION TO THE KCl CRYSTAL POTENTIAL
P. D. De Cicco *In its* Solid-State and Mol. Theory Group 15 Oct. 1964 p 9–14 ref (See N65-15517 06-26)

Energy bands for KCl were calculated at six equivalent points of the Brillouin zone, using a potential obtained by superposing the K^+ and Cl^- charge densities obtained from the Herman–Skillman program. The purpose of this report is to indicate the effects upon the band structure of the corrections to the "muffin tin" potential. Author

N65-15520 Massachusetts Inst. of Tech., Cambridge.
BAND STRUCTURE OF SILVER CHLORIDE AND SILVER BROMIDE
P. M. Scop *In its* Solid-State and Mol. Theory Group 15 Oct. 1964 p 15–60 refs (See N65-15517 06-26)

The Augmented Plane Wave method (APW) was used in calculating the electronic band structure of silver chloride and silver bromide crystals. The method takes advantage of the fact that the one-electron wave function is ionic-like near an ionic site and plane wavelike far from ionic sites. In considering the effects of perturbations on APW bands, attention is centered on the stated Γ_{15} and L_3 at the top of the valence band. The results of three perturbations, cubic field, mass velocity, and spin-orbit, are summarized in tables for both crystals. It is shown that the L_3 state (using single-group notation) is the highest point in the valence band after all perturbations are applied. Numerical details of APW calculations are presented. D.S.G.

N65-15521 Massachusetts Inst. of Tech., Cambridge.
LATTICE VIBRATION EFFECTS DUE TO IMPURITIES IN AN ALKALI HALIDE
Leon Gunther *In its* Solid-State and Mol. Theory Group 15 Oct. 1964 p 61–88 refs (See N65-15517 06-26)

Investigated were two important effects due to impurities on the lattice vibrations of alkali halides. Having set up the basic theoretical machinery, some idea of what to expect experimentally in the case of NaI+Li^+ was obtained. A simple approach to obtaining the impurity contribution to the phonon lifetime, which is applicable in thermal conductivity, was developed. Numerical results indicate a few dips due to resonance modes in the $\bar{K}$ vs T curve of NaI:Li^{+1} should be observed. It is therefore worthwhile to calculate the contribution of impurities to the correlation function

$$F(\bar{q}, t) = \sum_{\substack{ni \\ mj}} e^{i\bar{q}\cdot\bar{R}}{}_{nmij} \langle e^{-i\bar{q}\cdot\bar{x}_i(n)} e^{i\bar{q}\cdot\bar{x}_j(m,t)} \rangle_T$$

where $\bar{x}_j(m,t) = e^{iHt/\hbar}\bar{x}_j(m)e^{iHt/\hbar}$ and $\langle\ \rangle_T$ is a thermal average. The greater the coherence of the scattering, the greater the scattering amplitude. Thus, around the resonance frequencies, where there is an unusual degree of amplitude localization, a reduction in the scattering amplitude possibly of the order of magnitude of 1 part in N could be expected. Author

N65-15543# Microwave Associates, Inc., Burlington, Mass.
BROADBAND SOLID-STATE SWITCHES Quarterly Report, 1 Jul.–30 Sep. 1964
L. Nathanson [1964] 32 p
(Contract NObsr-89463)
(QR-5; AD-607736) OTS: $2.00

Presented are data pertaining to high-power measurements of the L/S-band prototype switch employing 28 diodes in a 6.25-ohm line section. In addition, high-power data are shown for the high-power testing of a C-band switch with 20 diodes in a 10-ohm line section. Other pertinent information discussed include PIN diode temperature data, and diode leakage current as a function of reverse bias under a high-power environment. Author

N65-15564# Joint Publications Research Service, Washington, D.C.
SOME ASPECTS OF ALLOY AND ALLOY-DIFFUSED PARAMETRIC DIODES
Chi-ts'ang Cho and Ching-ts'un Hsu 28 Jan. 1965 39 p refs Transl. into ENGLISH from Wu-Li Hsueh-Pao (Peking), v. 20, no. 4, Apr. 1964 p 311–336
(JPRS-28524; TT-65-30223) OTS: $2.00

CONTENTS:
1. THE FIGURE OF MERIT FOR THE ALLOY-DIFFUSED PARAMETRIC DIODE Chi-ts'ang Cho and Ching-ts'un Hsu p 1–22 refs
2. SERIES RESISTANCE AND CUTOFF FREQUENCY OF THE DIFFUSED PARAMETRIC DIODE Ching-ts'un Hsu and Chi-ts'ang Cho p 23–36 refs

N65-15574 Naval Ordnance Lab. Corona, Calif.
EDGE SHIFT AND m^* IN GaSb AS A FUNCTION OF FERMI LEVEL
H. Piller, V. A. Patton, and G. Zaeschmar *In its* Foundational Res. Proj. 1 Jun. 1963 p 77–84 refs (See N65-15565 06-34)

An investigation is reported of the energy band structure of semiconductors to provide details as a base for the prediction or interpretation of many of their electronic properties. It was found that the temperature dependence of the direct optical gap for different doping levels can be found from Faraday rotation measurements. Using the two-band model applied to GaSb with the Verdet and Hall coefficients, the calculated effective mass agreed with the mass calculated by the $k \cdot p$ perturbation method. The Faraday rotation was linear in wavelength-squared for the two low-concentration samples, but the sample of high concentration deviated somewhat from linearity, indicating a large carrier concentration in the <111> conduction band. D.E.W.

N65-15575 Naval Ordnance Lab., Corona, Calif.
INFRARED ABSORPTION SPECTRUM OF Ce^{3+} IN LaF_3
R. A. Buchanan, J. Murphy, and H. H. Caspers *In its* Foundational Res.Proj. 1 Jun. 1963 p 85–90 refs (See N65-15665 06-34)

Spectra were taken from crystals of $LaCl_3$ and LaF_3 doped with trivalent cerium. The electronic configurations of the atoms involved are discussed, and energy levels and electric dipole selection rules for Ce^{3+} in LaF_3 are given. Crystal absorption spectra from 2.6 to 5.3 microns near 4.2° K are shown for the two crystals, and vibronic lines for Ce^{3+} in LaF_3 are tabulated. It is concluded that more lines are observed in the Ce^{3+} spectrum than can be accounted for by pure electronic transitions alone. The evidence indicates a larger crystalline field splitting in Ce^{3+} than in other trivalent rare earths, with the possible exception of Yb. The studies of higher polarization confirmed the absence of symmetry higher than C_{2v} at the Ce^{3+} site in LaF_3. It is also concluded that lattice vibrations couple to electronic transitions to produce many vibronic lines. D.E.W.

N65-15602# Naval Ordnance Lab., White Oak, Md. Physics Research Dept.
SOUND VELOCITY IN HOT ROLLED NICKEL
D. L. Bradley Dec. 1964 19 p refs
(NOLTR-64-134; AD-451640)

Longitudinal sound velocity measurements in hot-rolled nickel were made as a function of temperature and pressure. The data were taken with an ultrasonic velocimeter at a frequency of 5 Mc/sec. The procedure in analyzing data is given together with tables and graphs. Author

N65-15619# McMaster U., Hamilton (Canada).
THE ACTION OF ADSORPTIVE INHIBITORS IN SOME CORROSIVE SYSTEMS
M. B. Ives Oct. 1964 34 p refs
(Contract Nonr-3925(00))
(TR-4; AD-608121) OTS: $2.00

Radio-tracer experiments were performed to deduce adsorption isotherms for iron adsorbed on lithium fluoride surfaces from dilute solutions of ferric chloride. The results support the concept of inhibitor control by action at the kink sites in an otherwise close-packed crystal surface, and the etch morphologies obtained may be successfully related to such a concept. It is proposed that the theories may be extrapolated to cases of metallic corrosion controlled by inhibitors that act by means other than the creation of a continuous passive film. Some of these examples are being studied. Author

N65-15628# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
VARIATION OF ELASTIC MODULI Technical Report 30 Sep. 1962–24 Jun. 1964
Arfon H. Jones Kirtland AFB, N. Mex., AF Weapons Lab., Nov. 1964 59 p refs
(Contract AF 29(601)-4601)
(WL-TR-64-103; AD-608378) OTS: $3.00

The variation of the bulk and shear moduli with pressure and temperature in an isotropic medium is considered. The bulk modulus can be evaluated for states at high pressure and temperature by use of the Mie–Gruneisen equation. The shear modulus follows on making additional assumptions, either that the solid exhibits a Debye frequency spectrum and a constant Gruneisen ratio and/or that the Poisson ratio is a constant. The values obtained for the shear modulus are found to be adequate for use in calculations of elastic-plastic wave propagation due to the insensitivity of the results to the variation in shear modulus. Author

N65-15741# Varian Associates, Palo Alto, Calif. Central Research Lab.
SOLID STATE MICROWAVE AND POWER DEVICES. VOLUME I: MAGNESIUM GERMANIDE Interim Technical Documentary Report No. 2
H. Kroemer, R. Fairman, W. Stein, and J. Kinoshita Oct. 1963 24 p refs
(Contract AF 33(657)-11015)
(Varian-307-2Q, Vol. 1; ASD-TDR-63, Vol. 1; AD-455648)

The zone refining of the magnesium needed for the preparation of the semiconductor, magnesium germanide, was started. The heat losses were reduced by insulating the Kanthal elements in the heater train with Kaowool and by covering the assembly with a sheet metal reflector. The Mg evaporation problem was solved by the addition of SO_2 to the gas stream. None of the four ingots of Mg_2Ge prepared was single crystalline, but one of them was so coarsely polycrystalline that fairly large single-crystal chips could be cut from it for further study. By alloying gold into these chips, p-n junctions were prepared. They exhibited true junction characteristics, with forward resistances as low as 1.5Ω, still fairly high-saturation currents of about 7 mA, still fairly low-dynamic resistances up to 140Ω, and breakdown voltages around 8V. Some progress was made in the etching techniques for Mg_2Ge. R.L.K.

N65-15742# Varian Associates, Palo Alto, Calif. Central Research Lab.
SOLID STATE MICROWAVE AND POWER DEVICES. VOLUME 2: INTEGRATED AMPLIFIER Interim Technical Documentary Report No. 3
Herbert Kroemer Wright-Patterson AFB, Ohio, ASD, Jan. 1964 57 p refs
(Contract AF 33(657)-11015)
(Varian-307-3Q, Vol. 2; ASD-TDR-63, Vol. 2; AD-455649)

This report describes the concepts of an iso-tunnel oscillator that can be built from a multicontact Hall-effect isolator and a multiplicity of tunnel diodes. Also, the possibility of temperature compensation by changing the diode biasing point is sketched. Necessary technological steps for the construction of an actual microwave Hall isolator for an iso-tunnel amplifier are described. The concepts and presumed advantages and problems of an iso-tunnel oscillator are given. Previous work is summarized in an appendix. D.E.W.

N65-15743# Varian Associates, Palo Alto, Calif. Central Research Lab.
SOLID STATE MICROWAVE AND POWER DEVICES: PREPARATION AND STUDY OF MAGNESIUM GERMANIDE Interim Technical Documentary Report No. 4
H. Kroemer, G. F. Day, R. D. Fairman, and J. Kinoshita Apr. 1964 22 p refs
(Contract AF 33(657)-11015)
(Varian-307-4Q; ASD-TDR-64; AD-455650)

Work is reported on a project to prepare and study the semiconductor Mg_2Ge, and to determine its feasibility and usefulness both for electronic devices other than bipolar transistors and, particularly, for integrated electronics. Improvement of the quality of doped and undoped Mg_2Ge single crystals is discussed, and the development of a new and greatly improved technique for the preparation of p-n junctions in Mg_2Ge is considered. Purer starting magnesium was obtained by zone refining, and magnesium losses during the Mg_2Ge preparation were eliminated by using a welded tantalum container. The new junction technique, using the evaporation of gold onto cleaned Mg_2Ge surfaces, and its subsequent alloy-diffusion into the crystal, led to greatly improved diodes.
D.E.W.

N65-15750# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
SPIN LATTICE RELAXATION BY LOCAL MODES: THEORETICAL CONSIDERATIONS Scientific Report No. 4
D. W. Feldman, J. G. Castle, Jr., and J. Murphy 10 Nov. 1964 26 p
(Contract AF 19(628)-3838)
(AFCRL-64-923; AD-609229)

A theoretical discussion of the temperature dependence of spin-lattice relaxation is given, in which the role of local modes at light-mass defects is emphasized. Diagrams, analogous to those used by R. P. Feynman in quantum electrodynamics, are used.
Author

N65-15756# Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
APPLICATION OF LIGHT AND IMAGE INTENSIFICATION Monthly Technical Engineering Report No. 15, 1-30 Sep. 1964
Z. Szepesi, ed. 19 Oct. 1964 10 p
(Contract N61339-1440)
(AD-426692)

A new furnace was received giving better temperature uniformity and allowing the sintering of PC layers in a controlled gas atmosphere. Experiments with the new furnace were started. More tests with CdSe-ZnSe mixture sintered layers were made. It was concluded that the addition of ZnSe does not improve the PC characteristics of the CdSe sintered layers. Further batches of CdSe (0.005 % Cu, 4% $CdCl_2$) power were made for plastic embedded PC layers. A specific conductivity of 3.1×10^{-10} mhos/cm was measured at 0.1 ftc illumination and 8×10^{3} V/cm field strength (100 V 5 mils thickness). On the other hand, cells with specific conductivities of higher than 10^{-7} mhos/cm were made (illumination 0.1 ftc and field strength 5×10^{3} V/cm). More image intensifier test panels were made, and a theoretical examination of the effect of a third layer in the construction of the panel was started. Author

N65-15763# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
QUARTZ CRYSTAL AGING EFFECTS Sixth Quarterly Report, 15 May-15 Aug. 1964
R. B. Belser and W. H. Hicklin 15 Aug. 1964 70 p refs
(Contract DA-36-039-AMC-02251(E))
(Rept.-6; AD-453198)

Initial data on the aging of 10-Mc AT-Cut quartz resonators bonded with five varieties of conducting cement were obtained, and extensive further aging analyses by X-ray diffraction methods of low frequency, 10-Mc, and 16-Mc resonators were undertaken. Preliminary results on bonding agent studies utilizing 66 10-Mc AT-Cut resonators, including about 13 bonded with each type of cement, gave the tentative order of preference of the bonding agents as du Pont 5605, Bondmaster, du Pont 5504-A, Pyroceram, and Bakelite. However, certain inconsistences in aging behavior of many of the resonators, currently believed due principally to surface finish, indicated the need for studies of additional resonators of each type before final evaluation. X-ray diffraction SID investigations of strain developed by globules of each type of cement on quartz plates are reported.
Author

N65-15791# Mallory (P.R.) and Co., Inc., Burlington, Mass. Lab. for Physical Science
INVESTIGATION OF ULTRA HIGH VACUUM SPUTTERED THIN FILMS Scientific Report No. 2
S. P. Wolsky 30 Nov. 1964 43 p refs Submitted for Publication
(Contract AF 19(628)-3840)
(AFCRL-64-977; AD-454939)

Germanium films were sputtered onto quartz and self-substrates in a low-pressure thermionically supported discharge. Reflection electron diffraction and X-ray examination showed that over comparable temperature ranges, the orientation of sputtered germanium on quartz films differed from that of evaporated films. Epitaxy was observed on self-substrates at 150° C. Electrical characteristics of evaporated and sputtered films were strikingly similar despite wide variation in substrate material and temperature and in deposition rates.
Author

N65-15820*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS Informal Monthly Report, 1-30 Apr. 1963
L. Yang, A. F. Weinberg, F. D. Carpenter, M. H. Horner, R. G. Hudson, et al 6 Jun. 1963 29 p refs
(Contract NAS3-2532)
(NASA-CR-60404; GACD-4312) OTS: HC $2.00/MF $0.50

The rate of vaporization of UC-ZrC cells for 1000-hour runs was established. The two cells were outgassed. The 30 UC-70 ZrC and the 90 UC-10 ZrC samples were prepared. The 90 UC-10ZrC sample is being outgassed. The second metallurgical life and performance test cell (MLP-B) containing a vapor-deposited W-clad UC emitter was operated for 110 hours. Studies of the controlling factors of vaporization, emission, and the mechanical properties of the UC-ZrC systems were made in relation to high-temperature properties. Studies of the irradiation properties were made for the unclad carbide and the clad capsules. Studies of new cathode materials, 30 UC-70 NbC, 90 UC-10 NbC, 30 UC-70 TaC, and 90 UC-10 TaC were made for vacuum emission and vaporization. The diffusion and diffusion-emission samples were prepared. R.E.S.

N65-15825# Centre National d'Etudes des Telecommunications, Issy les Moulineaux (France). Departement de Physique, Chimie, Metallurgie
PIEZOPHOTOVOLTAIC EFFECT IN SEMICONDUCTORS Final Technical Report, 1 Sep. 1963-31 Aug. 1964

[1964] 14 p refs
(Contract DA-91-591-EUC-3084)
(AD-451402)

Photo injection of excess carriers in a semiconductor, inhomogeneously strained by elastic stresses, should result in a photovoltage proportional to the concentration of excess carriers and to the applied force. For germanium, this photovoltage is calculated in terms of the deformation potential tensor. Experiments were performed that showed a good agreement between theory and experiment. Implications of these results for future research are discussed. Author

N65-15837# Microwave Associates, Inc., Burlington, Mass. Semiconductor Div.
HIGH POWER SEMICONDUCTOR PHASE SHIFTING DEVICES RELIABILITY TEST REPORT Final Special Progress Report, 1 Jul.–30 Sep. 1964
William W. Slavinsky, Jr. Nov. 1964 56 p
(Contract NObsr-87291)
(AD-608322) OTS: $3.00

The use of high-power semiconductor devices for phase shifting in array antennas is considered. The large number of these components in an operational system makes reliability data important. Progress made in this area is reported. This includes the continuation of the life tests through the 2000-hr readings. Data reduction shows that (1) the leakage current has a decreasing failure rate with time; (2) early leakage failures should be screened out by a properly designed burn-in; (3) alternate forward and reverse bias is a more severe test than continuous reverse bias; and (4) capacitance variations decrease as frequency increases. Author

N65-15841# Carnegie Inst. of Tech., Pittsburgh, Pa.
INEQUIVALENT MAGNETIC IONS IN DIHYDRATED FORMATES OF Fe^{++} AND Ni^{++}
G. R. Hoy, S. de S. Barros, F. de S. Barros, and S. A. Friedberg
28 Oct. 1964 9 p refs
(Contract Nonr-760(05); Nonr-760(20))
(TR-26; TR-5; AD-451400)

Several dihydrated formates including $Ni(HCOO)_2 \cdot 2H_2O$ and $Fe(HCOO)_2 \cdot 2H_2O$ crystallize in a monoclinic structure whose unit cell contains two each of two inequivalent types of metal ions. The temperature variation of the powder susceptibility, χ_p, of the Ni^{++} salt suggests that those ions on one type of site become cooperatively ordered near 15.7° K while the rest remain essentially independent even at 1.3° K. The χ_p for the Fe^{++} salt exhibits a huge peak at 3.68° K associated apparently with the long-range ordering of moments on sites of both types. Mössbauer experiments at 300° K on the Fe^{++} salt clearly distinguish ions on the two sites, the ratio of the effective electric field gradients being ~ 5 to 1. The smaller field gradient is assumed to characterize the site (type 1) approximately octahedrally coordinated by oxygens from six formate groups. The Mössbauer spectrum near the transition point differs from those measured at 300°, 77°, 20°, and 4° K. Author

N65-15842# Dynatech Corp., Cambridge, Mass.
INVESTIGATION OF ELECTROMAGNETIC AND THERMAL EFFECTS IN SUPERCONDUCTING GENERATORS Second Quarterly Report
H. W. Mooncai, C. J. Oberhauser, and J. M. Reynolds Oct. 1964 45 p refs
(Contract AF 33(615)-1574)
(Dynatech-485; AD-608250)

Described are the test runs after shakedown tests of the thermal and electrical effects in leads test apparatus, and the procurement and the instruction of the heatings effects in a superconductor test apparatus. Test runs of various lead materials were conducted in both liquid nitrogen and liquid helium. The test apparatus for the heating effect in a superconductor was built up and balanced with a dummy magnet in place of the real one. Author

N65-15847# Korad Corp., Santa Monica, Calif.
LASER MATERIALS RESEARCH. PART II: NEW MATERIALS Final Report
R. C. Pastor and R. H. Hoskins Wright-Patterson AFB, Ohio, AF Avionics Lab., Sep. 1964 117 p refs
(Contract AF 33(657)-11395)
(AL-TDR-64-195, Pt. II; AD-608104) OTS: $4.00

Two new laser hosts, Gd_2O_3 and La_2O_3, were developed, and data on laser operation with Nd^{+3} as the active ion are presented. Crystal growth problems are discussed, and spectroscopic data on various additives are given. Studies of the growth of several binary oxide hosts systems, together with preliminary spectroscopic data, are also discussed. Author

N65-15848# Korad Corp., Santa Monica, Calif.
LASER MATERIALS RESEARCH. PART I: RUBY IMPROVEMENT Final Report
R. C. Pastor and R. H. Hoskins Sep. 1964 123 p refs
(Contract AF 33(657)-11395)
(AL-TDR-64-195, Pt. 1; AD-608105) OTS: $4.00

The objective of this laser research program was the improvement of the crystal quality of Verneuil (flame fusion) ruby. The study was directed toward the overall achievement of a steady-state operation of this method of crystal growth. New approaches to the materials problems, experimental techniques, and results obtained are presented. Various subsidiary processes were investigated, with respect to a steady-state operation. Useful experimental parameters relevant to the successful matching of auxiliary processes are discussed. Author

N65-15863# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
PHOTOELECTRIC PHENOMENA IN TUNNEL DIODE STRUCTURES Technical Documentary Report, 1 Nov. 1962–30 Jan. 1964
J. R. Stevenson and E. J. Scheibner Wright-Patterson AFB, Ohio, AF Avionics Lab., 12 Oct. 1964 54 p refs
(Contract AF 33(657)-7867)
(AL-ASD-TDR-64-103; AD-608228) OTS: $3.00

The purpose of this investigation is to examine the possibility of obtaining data concerning the potential barrier at a metal-dielectric interface by the measurement of the photoresponse of the interface. A phenomenological description of the barrier is described, and a simple theory is developed as a tool for the analysis. The experimental approach to the problem is given, and preliminary photoelectric data is presented and discussed. The current vs voltage characteristics of the thin-film dielectrics are used as a control on sample characteristics. Author

N65-15870# Harvard U., Cambridge, Mass. Cruft Lab.
PARAMAGNETIC RELAXATION OF SOME RARE-EARTH IONS IN DIAMAGNETIC CRYSTALS
Chao-Yuang Huang 4 Aug. 1964 156 p refs
(Contract Nonr-1866(16))
(TR-452; AD-608278) OTS: $5.00

The pulsed saturation method at 8.9 kMc/sec was used to measure the spin-lattice relaxation rate for Eu^{2+}, Ho^{2+}, and

Tm^{2+} in CaF_2, for Yb^{3+} in YGG, YAIG, and LGG, for Nd^{3+} in YGG and YAIG, and for Sm^{3+} in lanthanum ethyl sulphate at low temperatures. Besides the expected direct, Orbach, and Raman processes, a process in which the spin relaxation rate is proportional to T^5 was observed for Eu^{2+} in CaF_2 in the temperature region $15° K < T < 30° K$. A pronounced anisotropy for Sm^{3+} in LES was also observed. The experimental data are in satisfactory agreement with the theoretical predictions based on the combined Van Vleck–Orbach theory. It is concluded that the spin-lattice relaxation of rare-earth ions at low temperatures is well understood, and a new theory about the spin-optical phonon relaxation is proposed. Author

N65-15875# Metals Research, Ltd., Cambridge (England).
DETERMINATION OF MASS ABSORPTION COEFFICIENTS AND FLUORESCENT YIELDS Final Technical Status and Scientific Report, 1 Sep. 1963–1 Sep. 1964
M. Cole et al Oct. 1964 31 p refs
(Contract DA-91-591-EUC-3094)
(AD-451332)

The experimental apparatus and techniques for the measurement of X-ray absorption in rolled metal foils are described. Measurements were made on the elements Al, Zr, Ni, Ta, Ti, and Be in the wavelength range 1 to 10Å. The results are discussed, and a detailed study of errors is given. The apparatus and techniques for the measurement of X-ray absorption in evaporated metal films are described. The difficulty of measuring the film suface density is also discussed. The apparatus for the measurement of fluorescent yields is described, including full drawings. The proposed technique is outlined, and a future program is given. A literature survey relating to absorption and fluorescence is summarized. D.E.W.

N65-15887*# National Aeronautics and Space Administration, Washington, D.C.
THE THEORY OF FERROMAGNETISM IN METALS [K TEORII FERROMAGNETIZMA V METALLAKH]
P. S. Kondratenko Feb. 1965 13 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 47, no. 4, 1964 p 1536–1543
(NASA-TT-F-9245) OTS: HC $1.00/MF $0.50

The methods of quantum theory are used to investigate the properties of a ferromagnetic metal. The interaction of Fermi excitations with spin waves is considered, and their contributions to the effect of temperature on thermodynamic quantities are established. The condition for the occurrence of ferromagnetism in a metal is established. Author

N65-15897# Battelle Memorial Inst., Columbus, Ohio.
THE STRUCTURE AND ANNEALING BEHAVIOR OF EXPLOSIVELY SHOCKED MgO CRYSTALS Final Report, 22 Nov. 1963–22 Nov. 1964
Mark J. Klein 5 Jan. 1965 21 p refs
(Grant DA-ARO(D)-31-124-G513)
(AROD-4434-2; AD-454670)

Structural studies of the response of crystalline materials to shock loading were confined for the most part to metals. In this investigation, the structure of explosively shocked magnesium oxide single crystals was investigated. Although ionic crystals with the rock-salt structure, such as MgO, were used as models to study the basic processes involved in plastic flow at low deformation rates, little is known about their response to high-velocity deformation. In this investigation, the structural changes induced in MgO crystals by plane shock waves were studied by etch-pit metallography and by electron-spin resonance. The experimental shock-loading procedures were not designed to study the mechanism of shock-wave propagation, but rather to induce high dynamic pressures in MgO crystals for subsequent structural studies. Author

N65-15898# Varian Associates, Palo Alto, Calif. Central Research Lab.
SOLID STATE MICROWAVE AND POWER DEVICES. VOLUME I: MAGNESIUM GERMANIDE Interim Technical Documentary Report No. 3
D. Atchley, G. F. Day, R. D. Fairman, J. Kinoshita, and H. Kroemer Jan. 1964 26 p refs
(Contract AF 33(657)-11015)
(Varian-307-3Q, Vol. 1; ASD-TDR-63, Vol. 1; AD-455649)

The object is to prepare and study the semiconductor Mg_2Ge, and to determine its potential feasibility and usefulness as a semiconductor for nontransistor solid state electronics, particularly integrated electronics. The Mg_2Ge preparation was brought under better control than previously. The first single crystal was prepared with an electron density approaching that of the best crystals reported in the literature. Also prepared were p-n junctions that had rectification ratios to 3800:1, and it was discovered that Mg_2Ge junctions are very readily passivated and are amazingly stable, not only in air but even if wet, e.g., from a plating bath. Several new studies were initiated, such as capacitance measurements, and a search for light emission. One of them is study of Ge-Mg_2 eutectic alloys that might have promise for thermoelectric, photoconductive and other uses. Author

N65-15906# Cornell U., Ithaca, N.Y.
EFFECT OF ELECTRON–PHONON INTERACTION ON ELECTRONIC SPECIFIC HEAT OF SIMPLE METALS
N. W. Ashcroft (Cambridge U.) and J. W. Wilkins Oct. 1964 10 p refs
(Contract Nonr-401(38))
(AD-608143)

The quantitative importance, and almost dominance, of the electron–phonon interaction in the deviation of the electronic specific heat from the free electron value in simple metals is reported. Only the metals Na, Al, and Pb were considered, since for them the band structure and the Fermi surfaces are relatively well known, and the phonon dispersion curves have been measured. With this information, the calculations were performed with no adjustable parameters. Although the approach used Green's functions method, the basic results are explained in a more traditional manner. Author

N65-15908# Iowa State U. of Science and Tech., Ames. Ames Lab.
MICROWAVE MOBILITIES OF HOLES IN P-TYPE GERMANIUM
Bou-Loong Ho and G. C. Danielson Aug. 1964 50 p refs
(Contract W-7405-ENG-82)
(IS-967)

Hall mobilities of an n-type (GN 1) and a p-type (GP 2) germanium single crystal were measured at a microwave frequency of 9 Gc/sec from 80° to 300° K. A bimodal rectangular cavity designed by Nishina was used. The microwave circuit was nearly the same as that described by Nishina except that the microwave signal was modulated by 1000 cps square-wave signal. The microwave mobilities measured (with sample size correction factor of 0.423 for n-type and 0.687 for p-type germanium), were compared with the corresponding dc Hall mobilities. For n-type germanium, the

discrepancy between the dc and microwave mobilities was believed to be predominantly due to the $\epsilon^{-1/2}$ dependence of the relaxation time (acoustical mode scattering). For p-type germanium, a large deviation occurred at low temperatures and was in agreement with the results obtained by Hambleton et al and by Watanabe. This result might be explained qualitatively as a combined effect of lattice and impurity scattering, particularly the effect of impurity scattering on the light mass holes. Author

N65-15913# Ohio State U. Research Foundation, Columbus. Antenna Lab.
PARAMETRIC INTERACTIONS OF LIGHT AND HYPERSONIC WAVES
D.A. Sealer and H. Hsu 15 Oct. 1964 33 p refs
(Contract AF 33(657)-10824)
(Rept.-1579-16; AD-454855)

A coupled mode analysis was developed of the interaction between optical and hypersonic waves, indicating the similarity of this interaction to a mechanism used in backward traveling wave-microwave devices. It was demonstrated how an acoustic wave can be amplified when it propagates through a parametrically pumped medium. The parametric interactions between the electromagnetic and the acoustic waves were considered for an isotropic solid. Some selection rules were developed for the interaction in which the wave vectors of the laser pump, the backward traveling optical wave, and the acoustic wave are all colinear. It was found that when propagation is parallel to the y-axis, transverse acoustic modes are also coupled, and the polarization of the backward traveling optical wave produced by oscillation is usually parallel to the pump wave. It was also shown that the coupling would be enhanced by operating close to one of the poles of the nonlinear susceptibility tensor. R.E.S.

N65-15921# Naval Ordnance Lab., White Oak, Md.
SURFACE STATES ON THE ($\bar{1}\bar{1}\bar{1}$) SURFACE OF INDIUM ANTIMONIDE
John L. Davis Nov. 1964 127 p refs
(NOLTR-64-73; AD-451009)

Measurements of the conductivity, photoconductivity, and high-frequency field effect mobility were made on the ($\bar{1}\bar{1}\bar{1}$) surface of indium antimonide, as a function of the charge applied to a field electrode adjacent to the sample. Using the theory of the surface space charge region and the experimental data, values of trapped charge as a function of surface potential were obtained. The data indicate two surface states, one near the valence band edge and one near the conduction band edge. Further measurements gave information on the capture probabilities of the states. A model of the surface states is proposed on the basis of the data. Author

N65-15923# Battelle Memorial Inst., Geneva (Switzerland). International Div.
SOLID STATE PROPERTIES OF NON-CONDUCTING MATERIALS OF SIMPLE MONATOMIC AND DIATOMIC SPECIES Final Technical Report, Mar. 1, 1963–Feb. 29, 1964
Laurens Jansen 31 Aug. 1964 150 p refs
(Contract DA-91-591-EUC-2846)
(AD-451031)

The stability of alkali halide crystals was analyzed, using the same methods as devised for rare-gas crystals, namely, an effective-electron model with a gaussian distribution for the effective electrons. First-order three-body interactions between ions were evaluated for different ratios of cation and anion sizes, and for different lattice dimensions in the two structures. Second-order three-body calculations were considered in analogy with those between rare-gas atoms. Since the nearest-neighbor distances in alkali halide crystals are considerably smaller than those in rare-gas solids (compression due to the Madelung energy), the contribution to the relative three-body energies due to multiple-exchange effects was investigated. The numerical results are in striking agreement with the experimental facts. The theory not only accounts for the cesium chloride structure of CsCl, CsBr, and CsI, it reproduces experimentally found transition pressures. Author

N65-15930# California U., Los Angeles.
[NUCLEAR MAGNETIC RESONANCE AND SPIN-MECHANISMS IN SUPERCONDUCTOR MATERIALS] Annual Report, 1 Oct. 1963–30 Sep. 1964
Raymond L. Orbach and Philip Pincus 8 Oct. 1964 21 p refs
(Contract Nonr-233(88))
(AD-607281) OTS: $1.00

Included are abstracts of the following articles: *Correlation Effect on the Nuclear Magnetic Resonance Line Width in Magnetic Materials, Effect of Paramagnetic Impurities on Nuclear Relaxation in Noncubic Metals, Second-Order Nonradiative Processes in $CaF_2:SM^{2+}$, Contribution of Configurational Mixing to the Axial Field Splitting of S-State Ions, Effect of Dipolar Fields on the Antiferromagnetic Spin Wave Spectrum, Cyclotron Resonance Involving Current Sheets in Aluminum, Magnetic Field Quenching of the Suhl-Nakamura Width in Antiferromagnets, Biquadratic Superexchange, Theory for the Contribution of Configurational Admixtures to the Zero Field Splitting of Paramagnetic Ions in an Axial Crystalline Field, The Attenuation of High-Frequency Phonons at Low Temperatures, NMR Measurements of Flux Distribution in Type II Superconductors,* and *Longitudinal Nuclear-Nuclear Coupling in Ferro- and Antiferromagnets.* R.L.K.

N65-15940# McMaster U., Hamilton (Canada).
THE MECHANICS OF IRON INHIBITION DURING DISSOLUTION OF LITHIUM FLUORIDE CLEAVAGES
Marjorie S. Baskin and M. B. Ives Sep. 1964 34 p refs
(Contract Nonr-3925(00))
(TR-3; AD-608120)

Radiotracers of iron are used to obtain adsorption isotherms for iron adsorbed on lithium fluoride surfaces from dilute solutions of ferric chloride. The isotherms are related to the observed etch morphologies and substantiate the argument that the condition for good crystallographically defined etch features is achieved by monokink adsorption of iron on the surface. Two distinct mechanisms are proposed for the effect of iron on the morphologies. At low iron concentrations the adsorption of iron at kinks is rate controlling, but at higher concentrations diffusion control becomes increasingly dominant. It is suggested that the diffusion barriers are increased by ferric ion complexes in solution. Isotherms determined under the steady state conditions provided by solutions saturated with lithium fluoride are more reproducible and applicable to adsorption theories than those determined from etchants. The β-track autoradiography and low-background counter methods are compared. Author

N65-15946*# Radio Corp. of America, Princeton, N.J.
MATERIALS AND METHODS FOR LARGE-AREA SOLAR CELLS Final Report, 1 Oct. 1962–30 Sep. 1964
P. Rappaport, S. G. Ellis, E. F. Pasierb, P. Vohl, R. R. Addiss et al 10 Oct. 1964 42 p refs
(Contracts NAS7-202; NAS3-2796)
(NASA-CR-54265) OTS: HC $2.00/MF $0.50

GaAs polycrystalline films were grown on molybdenum sheet. Attempts to produce p-n junctions in these films failed because of rapid impurity diffusion at defects. Barriers formed on these films at room temperature by the vacuum evaporation of Cu_2Se gave 3.9% sunlight efficiency. GaAs films formed by flash evaporation and sputtering showed high resistivity and anomalously high optical absorption. GaAs films on Al foil gave 0.1% efficiency with Cu_2Se barriers and promise a 50 watt/lb power-to-weight ratio. A new photovoltaic effect was discovered that may be used for direction sensing. Author

N65-15954 Carnegie Inst. of Tech., Pittsburgh, Pa.
SURFACE FIELD EFFECT DEVICE STUDIES FOR H..JH RESISTIVITY GALLIUM ARSENIDE. PART III: INTEGRATED BANDPASS AMPLIFIER STUDIES
Earl J. Charlson May 1964 27 p refs
(Contract Nonr-760(09))
(AD-603753)

An integrated band-pass amplifier device consisting of a surface field effect transistor placed on the end of a longitudinally vibrating crystal was investigated. The transistor was positioned so that there was little interaction between units besides direct electrical connection. As a result, the device may be characterized as a transistor with the drain permanently connected to one terminal of a crystal with the other crystal terminal floating. Two possible circuits to obtain band-pass amplification were investigated, and approximately 25% change in output around resonance was demonstrated. No attempt was made to optimize the selectivity of the device. Detailed measurements on oriented GaAs resonators are presented and, from these measurements, the elastic and piezoelectric constants were calculated. Author

N65-16001# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
DISPERSION ANALYSIS OF OPTICAL REFLECTIVITY
Alfred Kahan Nov. 1964 24 p refs *Its* Phys. Sci. Res. Papers No. 65
(AFCRL-64-912; AD-609847)

Methods of obtaining the optical constants of a material from the analysis of the reflectivity spectrum are given. Both the Kramers–Kronig integral relations and the classical oscillator theory are discussed and applied to the infrared lattice vibration data of Mg_2Sn and CaF_2. Author

N65-16008# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
CONTINUOUS ZONE REFINING
John K. Kennedy and N. Grier Parke, III (Parke Math. Labs., Inc.) Dec. 1964 135 p refs *Its* Spec. Rept. No. 14
(AFCRL-64-963; AD-609912)

This report is an effort to collect under one cover the existing theory of three continuous zone refining systems: the zone-void system, the zone-transport system, and the matter transport system. The steady-state equations that describe these systems are derived using consistent terminology, and under boundary conditions that account for the density change due to melting. The newly developed nondimensional steady-state equations are also derived, and the results of an extensive computer study based on these equations are presented in graphical form. Author

N65-16016# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
FAILURE MECHANISMS AT METAL-DIELECTRIC INTERFACES Third Quarterly Technical Documentary Report, 6 Jun.–5 Sep. 1964
David Peterson Griffiss AFB, N.Y., RADC, Dec. 1964 44 p refs
(RADC-TDR-64-459; AD-609995)

Thin film capacitors were used as a means of studying the changes induced at a metal dielectric interface by electrical and thermal stress. Long term stress testing indicated that a capacitor's stability may be grossly affected by surface contamination with water vapor prior to electroding. It was found that the capacitance and dissipation factor of gold electroded capacitors exhibited greatest changes at lower frequencies. During stress test, the capacitance and dissipation factor decreased during 1200 hours of accumulated test time, and then increased. The dc measurements indicated that leakage through the dielectric film could not account for the changes observed. Thin film anodized Ta_2O_5 capacitors prepared for radioactive tracer studies were placed on stress test. One group of units accumulated 12 weeks of stress time with a maximum increase of capacitance of 3.45 percent. A second group stressed at a higher level showed capacitance changes of from +6.7 percent to −4.5 percent. Author

N65-16020# General Electric Co., Schenectady, N.Y. Research Lab.
RESEARCH ON CdTe Quarterly Progress Report
R. E. Halsted, D. T. F. Marple, and B. Segall 31 Oct. 1964 9 p refs
(Contract AF 33(616)-8264)
(QPR-13; AD-610012)

The results of the research on band-edge fluorescent emission in CdTe are presented in the appended report. *Photoluminescence of Defect–Exciton Complexes in II-VI Compounds.* Considerable effort was made to prepare samples which exhibit a dominant emission process of near-band-gap energy at 4°K that is correlated with the presence of a dominant emission process of less than band-gap energy. The existence of an approximately constant ratio of the dissociation energy to the defect ionization energy for a wide range of acceptor ionization energies was observed. The best results for well-defined band-edge spectra were obtained by growing CdTe crystals from the melt of zone-refined CdTe containing 1 ppm dopant. A temperature study of the band gap of CdTe established that the T^2 variation of the band gap at low temperatures is due to hole interactions with acoustical phonons in the degenerate valence band. It was found that the low-temperature T^2 dependence of $E_g(T)$ is a characteristic that is common to the II-VI family of compounds. G.G.

N65-16031# Inland Testing Labs., Dayton, Ohio.
QUARTZ CRYSTAL RELIABILITY STUDIES Fifth Quarterly Report, 1 Jul.–1 Oct. 1964
Carleton E. Jones [1964] 50 p
(Contract DA-36-039-AMC-02350(E))
(Rept.-5; AD-453905)

Progress is reported in a study of various factors that produce failure in military-type quartz crystal units used in frequency control applications. The status of various lots of crystal units in the testing program is given, and the results of tests accomplished are summarized. It is noted that portions of the reliability test already completed show that the quality of crystal units in these lots is higher than that found in an earlier testing program. Data are presented in numerous charts that show frequency change vs testing time. D.E.W.

N65-16037# Milan U. (Italy). Istituto di Fisica
SOME APPLICATIONS OF PLANAR PN JUNCTIONS AS LIGHT EMITTERS IN SPACE RESEARCH
G. Boella, G. Degli Antoni, and P. Podini 10 Sep. 1964 14 p refs
(Grant AF-EOAR-63-86)
(AFCRL-64-877; AD-610336)

Details are presented on the performance of some types of silicon transistors used as light emitters. The results show that the form of the spectrum does not depend appreciably on the current flowing through the junction, but does depend slightly on the type of transistor used, and very little on temperature. The change of temperature of the transistor case is an important factor in performance. Some applications are discussed: the calibration of photomultipliers, the performance of feedback on the photomultiplier controlling the junction current with the anode current, and use as photomultiplier gain stabilizers. An analog-digital servosystem is briefly discussed. E.W.

N65-16038# Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
PARAMAGNETIC RELAXATION IN CRYSTALS Final Report, Nov. 1, 1963–Oct. 31, 1964
J. G. Castle, Jr. and D. W. Feldman 31 Oct. 1964 11 p
(Contract AF 19(628)-3838)
(AFCRL-64-924; AD-609971)

Several studies of paramagnetic relaxation in crystals were carried out. The results include: (1) more accurate relaxation data characteristic of the vacancy-type defects in crystalline quartz; (2) relaxation data characteristic of similar defect centers in GeO_2 class; (3) interpretations of these data in terms of a large local strain at frequencies characteristic of mechanical resonance modes localized around the defect; (4) discovery of a temperature dependence determined by the high frequency local mode associated with atomic hydrogen trapped in calcium fluoride; and (5) discussion of relaxation theory by means of relaxation diagrams, analogous to those introduced in quantum electrodynamics by R. P. Feynman. Author

N65-16066# Arizona U., Tucson.
ELECTRICAL AND MAGNETIC PROPERTIES OF ORGANIC SOLIDS Final Report
Gordon Tollin 27 Nov. 1964 40 p refs
(Contract AF 19(628)-414)
(AFCRL-64-989; AD-610102)

The electrical and magnetic properties of single crystals of 1 to 1 charge transfer complexes of protonated flavins and phenols were investigated. The results indicate the following pattern for the electronic behavior of these materials: Charge carriers produced in the dark or by illumination are rapidly trapped, and contribute to the electrical conductivity by virtue of thermal release from trapping sites. The photocurrent is composed essentially equally of positive and negative carriers, with a rate limitation imposed by carrier migration. The EPR results indicate that complete electron transfer processes can occur at lattice imperfection sites, which are produced either during the crystallization process or by removal of solvent from already formed crystals. The unpaired spins so produced behave as localized, doublet state, free radicals. Author

N65-16094# Microwave Associates, Inc., Burlington, Mass.
RESEARCH ON MILLIMETER-WAVE GENERATION TECHNIQUES Final Report, 1 Apr. 1963–1 Apr. 1964
A. Uhlir, Jr. et al Wright-Patterson AFB, Ohio. AF Avionics Lab., 24 Nov. 1964 96 p refs
(Contract AF 33(657)-10925)
(AFAL-TR-64-270; AD-609625)

A detector was developed for use in an electro-optical approach to the generation of millimeter-wave energy using semiconductors. A PIN heterojunction structure was designed for optimum quantum efficiency, maximum operating frequency, and a spectral response consistent with potential light sources. The GAS-GaAsP material system was used, the structure, of which was fabricated by a three-step process. Quantum efficiencies of greater than 40% and a broad spectral reponse were obtained. From a lack of increase in efficiency with increase in space-charge width (increase bias), it was concluded that the photon absorption and conversion to hole-electron pairs occurred in the zero bias space-charge width (1 micron). This indicated a basic fast mechanism and therefore a high-frequency operation capability. In a separate approach to the generation of millimeter-wave energy, microwave oscillations have been observed in bulk GaAs during the application of short video pulses. The frequencies were found to be in the uhf and L-band range. Obtaining a low resistance contact to the N-type material is a problem. R.L.K.

N65-16115# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
OPTOELECTRONIC FUNCTIONAL ELECTRONIC BLOCKS Interim Engineering Report No. 5, 1 Aug.–31 Oct. 1964
J. R. Biard 8 Dec. 1964 81 p refs
(Contract AF 33(657)-11552)
(Ti-03-64-88; AD-609509)

Investigations of optoelectronic phenomena are being performed in an effort to extend the applicability of integrated circuits. The combination of the isolation feature of optical coupling with existing silicon integrated circuit technology has suggested a new series of Optoelectronic Functional Electronic Blocks which provide functions previously impossible or extremely difficult to attain in solid-state form. The development of semiconductor and measurement technology necessary to enhance the capabilities of Optoelectronic Functional Electronic Blocks includes: (1) a study of the problems associated with high-index glasses used as optical coupling media; (2) the description of a shaped flat light source to improve optical coupling efficiency; (3) a study of diffusion process variables; (4) a study of dislocation density and its relationship to device behavior; (5) a description of some $GaAs-GaAs_{(x)}P_{(1-x)}$ transparent structures; (6) transient photoresponse measurements for room temperature and liquid nitrogen temperature; (7) a comparison of the optical and electrical characteristics of mesa and planar GaAs diodes; and (8) a description of a light-spot scanning apparatus. Author

N65-16148# University Coll. of North Wales, Bangor (England).
AN INVESTIGATION OF NEW MATERIALS SUITABLE FOR THE FABRICATION OF SPACE CHARGE AMPLIFIERS Final Report, 1 Oct. 1963–30 Sep. 1964
R. H. Tredgold [1964] 15 p
(Contract DA-91-591-EUC-2855)
(AD-451467)

Reasons for studying aluminium nitride in the context of space charge conduction are discussed. Various attempts to grow single crystals of this material are described. The successful method involves the recrystallization of sintered AlN rod from the vapor phase in an atmosphere of nitrogen. Measurements of dark current using both indium and gold electrodes

are reported. Photocurrents have been observed by illuminating the anode via a semitransparent gold electrode. A simple calculation based on the theory of Lampert indicates a trap density of about 10^{12} cm^{-3}. Attempts to grow aluminium nitride layers on the 111 face of single crystals of aluminium are described. Attention has been concentrated on evaporating layers of aluminium in vacuo and subsequently admitting high purity nitrogen to the apparatus and heating to above 530° C. This technique produces a film which has a specific conductivity which agrees well with that obtained on single crystals. Author

N65-16170# Purdue U., Lafayette, Ind. Solid-State Energy Conversion Research Lab.
QUANTUM EFFICIENCY OF RADIANT ENERGY PHOTONS IN SEMICONDUCTORS
G. C. Jain [1964] 25 p refs Presented at the 6th Colloq. on Combust. and Propulsion, Cannes, France, 16–20 Mar. 1964

The efficiency of conversion of radiant energy to electrical energy depends upon the efficiency with which a radiant energy photon is capable of generating a useful charge carrier. Using Shockley–Read statistics, a general expression for the quantum efficiency of a monochromatic incident radiant photon was derived in terms of the absorption coefficient $(L_\lambda)^{-1}$ of the incident wavelength in the semiconductor material, the minority carrier lifetime and the thickness of the exposed layer of the p–n cell. Germanium cells show a great potential for solid-state conversion of energy from radiant sources. Germanium cell analysis indicates a strong dependence of the quantum efficiency on the thickness of the exposed layer. Assuming an n–p cell, quantum efficiencies of 90% and higher could be obtained for all wavelengths from very small values to 1.5×10^{-4} cm, if the thickness of the exposed n layer is kept in the range of 50μ to 250μ. For monochromatic wavelengths greater than 1.5μ but less than 1.77μ, the cutoff wavelength for germanium, the quantum efficiency decreases rapidly with increasing wavelength. Author

N65-16225# Ohio State U. Research Foundation, Columbus.
PROPERTIES OF ELECTRONIC AND MAGNETIC MATERIALS OF CRYOGENIC TEMPERATURES Technical Documentary Report, 1 Apr. 1963–1 Jan. 1964
J. G. Daunt Wright-Patterson AFB, Ohio, AF Mater. Lab., Sep. 1964 11 p refs
(Contract AF 33(657)-10844)
(ML-TDR-64-176; AD-608041)

This work constitutes the initial stage of a program of investigation of the electrical, thermal, and magnetic behavior of Mo-Re alloys in their superconducting and normal states. The work covers data obtained on the electrical resistivity and thermal conductivity of Mo-Re (50% Re) wires as a function of magnetic fields at liquid helium temperatures. The magnetic fields used had intensities up to 50 kG, produced by a superconducting solenoid. Author

N65-16236# Motorola, Inc., Culver City, Calif. Integrated Electronics Research Dept.
MINIATURE THIN FILM INDUCTORS (MODIFICATION NO. 2) Third Interim Report, 1 Dec. 1963–1 Mar. 1964
F. R. Gleason 31 Mar. 1964 18 p
(Contract NObsr-85397)
(Rept.-4003-3; AD-434051)

Work was directed toward obtaining larger inductance values. The ferrite thickness experiments indicated conclusively that a thickness of ferrite material in the order of 40 mils is required to obtain the maximum effect to the magnetic material. In order for the ferrite film to produce an inductance increase at least comparable to bulk ferrite, a higher annealing or sintering temperature after deposition is required. Ferrite process technology showed that this temperature should be at least 1200° C. To achieve this temperature and have a coil, encapsulated with the film, and to retain continuity, the coil melting point must be elevated. A suggested method is to add rhodium to the gold. D.E.W.

N65-16247# Michigan U., Ann Arbor. Electron Physics Div.
HARMONIC SPIN COUPLING IN CHROMIUM-DOPED RUTILE Technical Report No. 77
D. H. Paxman and G. I. Haddad Oct. 1964 65 p refs
(Contract AF 33(615)-1553)
(Rept.-06349-4-T; AD-450982)

This report describes work carried out on harmonic cross-relaxation processes in Cr^{3+} doped rutile (TiO_2). In particular, attempts to observe 2 to 1 harmonic processes are described. A brief discussion of the theory of cross relaxation is given, and an analysis of the rate equations for a typical case of interest is presented. Author

N65-16250# Army Electronics Research and Development Agency and Lab., Fort Monmouth, N.J.
TECHNOLOGY FOR PNP PLANAR SILICON TRANSISTORS: SWITCHING AND AMPLIFYING
1pArmond P. La Rocque, Robert S. Yatsko, Alex Rogel, Raymond

Jackson, and Vicent E. Rible Mar. 1963 29 p refs
(USAELRDL-TR-2339; AD-408190)

Processes and techniques requires for fabrication of experimental planar pnp silicon transistors were developed and demonstrated as feasible. Processes involved include material preparation, antimony base diffusion, boron emitter diffusion, oxide masking, photoresist techniques, simultaneous gold metalizing of emitter and base regions, collector alloy contact and basing, and thermocompression bonding. Initial transistors have typical dc Beta values of 35 to 40 and F_T values as high as 350 Mcs. Processes described were also used in preliminary fabrication of solid-state microcircuit passive components. Author

N65-16251# Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research
BREAKDOWN STRENGTH OF ALKALI HALIDES AS FUNCTION OF TEMPERATURE AND DISLOCATION DENSITY
Rolf Nevald Oct. 1964 22 p refs
(Contract AF 33(616)-8353; Nonr-1841(10))
(TR-193; AD-608827)

The dc breakdown strength of NaF, NaCl, RbBr, and KI single crystals was measured from 4.2° to 400° K. The characteristics consist of a slow rise at low temperatures followed by a steep decrease in the high temperature region. The positive slopes at low temperature conform to theoretical expectation based on the von Hippel criterion of impact ionization; the absolute value of the breakdown strength lies about 25% to 50% below that predicted by Callen's calculation. The position of the maxima for the different crystals corresponds approximately to the temperature where the ionic current densities in the various materials are identical. The electric strength of NaCl crystals was measured as function of temperature for four different dislocation densities. Low dislocation concentrations, as found in normally prepared

crystals, have no noticeable effect. For high dislocation densities, the rising section of the characteristic flattens, the falling section steepens, and the maximum shifts to lower temperatures. These trends conform with previous findings on the effect of addition agents and the transition from crystal to glass. The dislocations were found to cause a dielectric relaxation spectrum in the 10^3 to 10^8 Hz region. Author

N65-16254*# AVCO-Everett Research Lab., Everett, Mass.
CURRENT TRANSFER IN CONTACTS INVOLVING SUPERCONDUCTORS Research Report No. 193
E. Lucas, Z. J. J. Stekly, C. Laverick, and G. Pewitt (Argonne Natl. Lab.) Sep. 1964 36 p Presented at 1964 Cryog. Eng. Conf., Pa. U., 8–21 Aug. 1964
(Contracts NAS8-5279; AF 04(694)-414; AEC-31-109-38-1498)
(NASA-CR-60532; BSD-TDR-64-110; AVCO-Everett Res. Rept.-193)

A theoretical analysis for the transfer of current between a power lead and a superconductor is given. This analysis assumes that a uniformly distributed surface resistivity exists between the superconductor and the normal conductor. Experimental results with contacts between superconductors and power leads were obtained during the course of experiments with short samples and small solenoids. These results are presented. The theoretical predictions were checked experimentally and the results are given. It is concluded that the maximum current that can be transferred through a joint, is a function of the following: the magnitude and direction of the magnetic field at the joint, the cooling of the joint, and the contact resistance. Joints should be located in low field regions and aligned parallel to the magnetic field. Reliability can be improved by paralleling joints. Crimped joints with indium coated wires and tubes are satisfactory for most applications. Author

N65-16320*# General Dynamics Electronics, Rochester, N.Y. Research Dept.
LASER MODULATION AT THE ATOMIC LEVEL Monthly Report No. 5, 1–30 Nov. 1964
E. G. Brock, F. C. Unterleitner, Sr., Y. C. Kiang, and J. F. Stephany 10 Dec. 1964 8 p refs
(Contract NASw-1008)
(NASA-CR-60572) OTS: HC $1.00/MF $0.50

Population inversion as a function of peak magnetic field was measured for a 90° ruby rod. Unlike the 0° rod, minimum inversion coincides with zero magnetic field, and the slope of threshold population inversion versus magnetic field is more than an order of magnitude higher in the high field region for the 90° rod. Rough estimates of the Zeeman splitting to be expected from the lines involved in laser emission at room temperature and at liquid nitrogen temperature have been made. If the crystal field terms in the Zeeman splitting calculation are ignored, each of these lines should split into four components in a magnetic field, the splitting for the room temperature line being approximately four times that of the low temperature line. The primary purpose of these calculations is to give an order of magnitude estimate of the frequency shifts to be anticipated in the pulsed homogeneous field experiments with YAG:Nd^{3+} laser. Author

N65-16327*# Colorado U., Boulder. Atmospheric and Space Physics Lab.
OPTICAL CONSTANTS OF METALS IN THE FAR ULTRAVIOLET AND THEIR RELATION TO ENERGY BAND STRUCTURE Scientific Report No. 1, Jun. 1962–May 1963
Luke Steven Gournay 1 May 1963 111 p refs
(Contracts NASr-86; AF 19(628)-287)
(NASA-CR-50680) OTS: HC $4.00/MF $0.75

The real and imaginary components of the indices of refraction, the optical constants, of silver, a silver–indium alloy, gold, gold–aluminum alloys, and aluminum were studied in the wavelength range of 304 to 1671 A. Electrical conductivity as derived from the optical constants is shown to be related to interband transitions in these metals. A model was constructed which permits computation of conductivity on the basis of these transitions and the energy band structure of the metal. The effectiveness of this model is shown for the metals studied. An analysis of results for silver–indium alloys indicates a breakdown of the rigid band concept. A fermi surface that has less contact at the brillouin zone faces and a less distorted shape is indicated for the alloy. The modified energy band structure is presented and discussed. The relation between the energy gap at brillouin zone faces and the interband transition probability is developed, and data are presented that demonstrate its relative importance. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-15665# FMC Corp., Buffalo, N.Y. Inorganic Chemicals Div.
BECCO 98° H_{202} AS A MONOPROPELLANT AND OXIDIZER FOR SPACECRAFT POWER PLANTS
James C. McCormick [1964] 19 p

The relative advantages and disadvantages of 90% and 98% hydrogen peroxide for application as a monopropellant or an oxidizer in small rocket engines are discussed. Specific advantages shown by 98% H_2O_2 over the 90% solution include a 12% weight saving as a monopropellant; a weight saving with fuels such as hydrazine, pentaborane, MMH, UDMH, and JP-4; a rapid hypergolic reaction with hydrazine that is ideal for bang-bang operation in attitude control systems; better storage properties; and better container material compatibilities. D.E.W.

N65-15838# Hughes Aircraft Co., Culver City, Calif.
LIQUID ROCKET PROPELLANTS IN ZERO GRAVITY Selected Bibliography, Jan. 1962–Sep. 1964
Janice L. Hanks, comp. Oct. 1964 6 p refs
(LS-BIB-64-2)

N65-15885# Aerojet-General Corp., Sacramento, Calif. Propellant Ballistics Dept.
WING VI MINUTEMAN IGNITION STUDY Final Report
R. L. Lovine and L. Y. Fong Apr. 1964 96 p refs
(Contract AF 04(694)-258)
(TM-249-SRP; AD-452527)

The results of arc-image furnace propellant ignitability tests were collected and analyzed. Heat flux generated at the grain surface by the igniter efflux was obtained experimentally and correlated with standard dimensionless similitude relations. The information on propellant ignitability and igniter-induced heat flux is combined with an internal ballistic analysis of the

igniter-port volume system. The result is a description of the phenomena of motor ignition, and a safety factor for the Wing VI Minuteman motor is specified. Motor internal ballistics during the ignition transient were investigated, special attention being given to the ignition pressure peak. The causes of this event are isolated, and computation methods are given. A restricted form of the generalized motor internal ballistics is applied to the BPN pyrotechnic initiating device. Author

N65-15912# American Oil Co., Whiting, Ind. Research and Development Dept.
BASIC STUDY OF SORPTION OF ORGANIC FUELS DURING OXIDATION AT ELECTRODES Final Report, Sep. 13, 1961–Oct. 21, 1964
Robert J. Flannery, Gerald Aronowitz, Emil M. Banas, Marvin J. Den Herder, John A. Donohue et al Dec. 1964 125 p refs
(Contract DA-11-022-ORD-4023; ARPA Order 247-61; ARPA Order 247-62)
(M64-341; AROD-3472-4; AD-454676)

Of the many techniques studied, the radiolabeled sorption, differential capacitance, voltage step and potential sweep techniques were found to be most useful for studies of selected light hydrocarbon, methanol and formic acid fuels. For the radiolabeled sorption technique, the most difficult development problem was achieving an adherent, 2000 Å-thick platinum film-electrode on a thin (6 mil), mica substrate through which the activity of the radiolabeled fuel is measured. This problem was solved by using a graded Ta oxide -Ta layer between the mica and the platinum. Results of differential capacitance and electro-oxidation studies of methanol, light hydrocarbon, and formic acid fuels are also presented. Results of differential capacitance and electro-oxidation studies of methanol, light hydrocarbon, and formic acid fuels are also presented. Author

N65-16058# Thiokol Chemical Corp., Denville, N.J. Reaction Motors Div.
HYPERGOLIC IGNITION AT REDUCED PRESSURES Five-Month Progress Report, 1 May–30 Sep. 1964
A. Corbett, T. Seamans, B. Dawson, and C. Cheetham Edwards AFB, Calif., AF Rocket Propulsion Lab., Dec. 1964 80 p
(Contract AF 04(611)-9946)
(AFRPL-TR-64-175; AD-610144)

Unconfined impingement tests are being conducted in a large vacuum chamber to define an ignition model for hypergolic propellants and to investigate concepts for reducing ignition delay and resultant pressure spikes. The test setup, experimental program schedule, and concepts for reducing ignition delay are discussed. Results are reported on ignition delay as a function of injection parameters, environmental conditions and concepts such as injector modifications and propellant additives for reducing delay for tests performed with N_2O_4 and IRFNA as oxidizers and hydrazine-type fuels. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-15876*# Cosmic, Inc., Washington, D.C.
DEVELOPMENT OF A CHARGED COLLOID SOURCE FOR ELECTROSTATIC PROPULSION Report No. 62
D. Gignoux, H. F. Anton, and J. J. Shea Oct. 1964 78 p refs
(Contract NAS3-4106)
(NASA-CR-54176) OTS: HC $3.00/MF $0.75

A large number of tests were performed with a rotating nozzle source of induction-charged colloid. The geometry was improved, resulting in an increase of the charge-to-mass ratio by one order of magnitude with respect to a previous program. Analytically, the ideal propellant was shown to have high viscosity, low density, low surface tension, low vapor pressure, and high conductivity. The experimental values of the system parameters agreed conclusively with those predicted analytically. The search for a better propellant disclosed several promising avenues. Beam currents up to 1.5 milliamperes were obtained. The system has very promising application to high-efficiency electrostatic thrustors. Author

N65-15996# Aerojet-General Corp., Sacramento, Calif.
DEVELOPMENT, DESIGN, FABRICATION AND DEMONSTRATION OF PACKAGEABLE, HIGH-EXPANSION RATIO NOZZLES FOR SOLID PROPELLANT ROCKET MOTORS Second Quarterly Report, 1 Sep.–30 Nov. 1964
R. E. Morris 15 Dec. 1964 61 p refs
(Contract AF 04(611)-9896)
(Rept.-0874-82-2Q; AD-609290)

The subscale test program was successfully completed. The progress on the demonstration program was as follows: (1) The design was completed on the metallic and elastomeric exit cones. (2) The first four motors were cast; the second motor has a bond separation and will require refurbishing. (3) The igniters were completed. (4) The nozzles were partially fabricated. Author

N65-16074# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF FIRING ROCKET SHELLS ON THE PERFORMANCE OF TURBOJET POWER PLANT
J. Szymankiewicz 12 Nov. 1964 8 p Transl. into ENGLISH from Wojskowy Przegl. Lotniczy (Warsaw), no. 8, 1963 p 22-28
(FTD-TT-64-388/1+2; AD-608451)

The multistage axial compressors of high secondary delivery and of compression high enough to attain the great thrust of a turbojet engine are sensitive to disruption in flow parameters in the intake channel, which results when a rocket missile is launched. At this time a certain amount of gas enters the powerplant and contributes to the reduction of oxygen content in the combustion and afterburning chambers. Two systems were found to alleviate this flow disruption: a system to briefly reduce the amount of fuel delivered to the combustion chamber, and a system to totally interrupt fuel delivery to the combustion chamber, with automatic reverse starting of the powerplant. These systems are considered only temporary solutions. R.E.S.

N65-16084# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POWER PLANTS OF COSMIC SHIPS OF THE FUTURE
Z. Rezbicki 7 Jan. 1965 14 p Transl. into ENGLISH from Wojskowy Przegl. Lotniczy (Warsaw), v. 17, no. 3, 1963 p 56-63
(FTD-TT-64-624/1+2; AD-455510)

A review is made of the powerplants used for dispatching and maintaining flight of spacecraft. A discussion of the multistage rockets, the ion- and plasma-produced power, and the basic use of energy on the inertia principle is given. Three main elements are discussed as components of the systems: (1) power source, (2) current converter, and (3) ion or plasma thrust chamber. Brought into the discussion is the use of

electric drive systems for sustaining flight after the ship has pulled away from the force of gravity, such as in interplanetary travels. R.E.S.

N65-16091# Atlantic Research Corp., Alexandria, Va.
FEASIBILITY DEMONSTRATION OF PYROLYTIC GRAPHITE COATED NOZZLES Third Quarterly Progress Report, 1 Aug.–31 Oct. 1964
James D. Batchelor 25 Nov. 1964 19 p
(Contract AF 04(611)-9708)
(RPL-TDR-64-176; AD-608721)

Improvements were made in preparing crack-free subscale coated inserts. Flaw-free coatings as thick as 54 mils were prepared. Application of this improved art to full-scale inserts is underway. Stress analysis indicated the merit of alternate substrate materials and deposition work with these is underway. A successful 35-second subscale firing was made, but during a 60-second firing discrete coating losses were observed from a coating containing a known separation. This behavior was analogous to early subscale experience. Author

N65-16152# Joint Publications Research Service, Washington, D.C.
TEST OF MODEL EXHAUST SILENCERS FOR MARINE GAS TURBINE ENGINES
Yu. A. Bordovitsyn, N. S. Idiatullin, and V. A. Filin 12 Feb. 1965 9 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), v. 30, no. 2, Feb. 1964 p 26–27
(JPRS-28733; TT-65-30318) OTS: $1.00

Three silencer variants were selected. The first variant envisages a silencer with a wedge and diffuser, installed in the GTU's [gas turbine engine] gas conduit with 10 ribs. The principle on which the second silencer variant operates is based on the formation at the boundaries of the exhaust stream of steady vortical currents (for the cooling air and the exhaust stream) with a contrary direction of circulation. Installed for this purpose at the cutoff of the gas conduit nozzle are internal and external vortex generators, which are steel plates bent back in the direction of the exhaust stream and the walls of the gas conduit at an angle of 60°. The third silencer variant consists of a tapering perforated attachment installed on the nozzle of the GTU. Noise suppression is effected by dividing the exhaust stream into minute streams, discharged via the holes in the attachment. Special experimental apparatus was created to test the silencers. Author

N65-16182# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOINT OSCILLATIONS IN GAS TURBINE ENGINES
A. F. Gurov 5 Nov. 1964 144 p refs Transl. into ENGLISH of the Publ. "Sovmestnyye Kolebaniya V Gazoturbinnykh Dvigatelyakh". Moscow, Gos. Nauchno-Tekhn. Izd. Oborongiz, Issue 144, 1962
(FTD-MT-64-68; AD-608455)

A method of dynamic compliance was used to find the frequency of free oscillations of a gas turbine engine system consisting of a revolving rotor placed on yielding supports, and a yielding body secured to the engine frame. This permitted calculation of critical rpm and resonance regimes, and of joint oscillations of the engine shaft and its adjacent parts. Also indicated are methods for designing dangerous resonances out of engine systems, such as a change in the engine support of the system body-rotor of the engine. Diagrammatic figures and integral methods for determining resonance dependence are included. M.G.J.

N65-16187# Naval Propellant Plant, Indian Head, Md. Quality Assurance Dept.
GENERAL SURVEILLANCE OF THE 2.25-INCH ROCKET MOTOR MK 3 MODS 2 AND 3 (MOUSETRAP)
R. V. Elliott 21 Sep. 1964 27 p refs
(QE/NPP-64-8; AD-450977)

Testing included critical inspections of motor assemblies and components, static firings at extreme temperatures, igniter tests, and chemical–physical analyses. The results of these tests and analyses indicate that the general condition of these units is good, but defects exist in the igniter circuit, i.e., an excess of open circuits and high resistances. These defects are attributed to flaked or cracked ignition lead insulation, voltage leakage at the fin contact posts, and corroded fin bands. It is concluded from strict consideration of ballistic and chemical–physical test results, that performance of these units may be expected to remain satisfactory until the grain has aged at least 25 years. However, the igniter circuit defect area places the unit in a suspect status. Author

N65-16234# Pennsylvania State U., University Park.
BIBLIOGRAPHY ON COMPRESSION IGNITION ENGINE LOW TEMPERATURE PROBLEMS Engineering Research Bulletin
W. E. Meyer Sep. 1964 116 p refs Available from Pennsylvania State U., $3.00
(Contract DA-36-034-ORD-3199 RD)
(B-90; AD-451102)

This revised cumulative issue contains a variety of publications that are related to and/or cover the problems of adapting compression ignition engines to operation at low temperatures. Each entry has a locating key. A subject index lists the keys pertinent to the various topics of the classified system. G.G

N65-16259*# Chrysler Corp., Huntsville, Ala. Space Div.
SA-7 VEHICLE AND LAUNCH COMPLEX FUNCTIONAL DESCRIPTION. VOLUME VIII: H-1 ENGINE AND HYDRAULIC SYSTEM
Feb. 1964 29 p
(Contract NAS8-4016)
(NASA-CR-60547; HEC-D041, Vol. VIII) OTS: $2.00/MF $0.50

Functional descriptions are given of the engine system and of the hydraulic system of the SA-7 vehicle. Various operations are described, such as engine purge, launch preparations, engine starting, steady-state operation, engine shutdown, engine drain, hydraulic system filling, prelaunch hydraulic system operations, the hydraulic system during flight, and hydraulic system draining. D.E.W.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-15442 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE IMAGE OF THE SUN IN THE DISTANT ULTRAVIOLET REGION OF THE SPECTRUM

I. A. Zhitnik, V. V. Krutov, L. P. Malyavkin, and S. L. Mandel'shtam *In its* Cosmic Res. 13 Jan. 1965 p 170–184 refs (See N65-15432 06-30)

By means of the equipment mounted in a geophysical rocket launched on June 6, 1963 to an altitude of 500 km, photographs were obtained of the sun in the spectral region between 170 and 400 A. The He II lines and continuum have made a significant contribution to the image that was obtained. The regions of elevated radiation intensity are situated over facular fields. Author

N65-15443 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE DISTRIBUTION OF COSMIC-RAY INTENSITY IN THE ATMOSPHERE UP TO AN ALTITUDE OF 500 km

Yu. G. Shafer, V. D. Sokolov, N. G. Skryabin, V. F. Lyutenko, A. V. Yarygin et al *In its* Cosmic Res. 13 Jan. 1965 p 185–193 refs (See N65-15432 06-30)

It is shown that the intensity of the primary cosmic radiation in the middle latitudes experiences no significant secular changes, and at altitudes of 100 and 500 km is equal to 0.125 and 0.135 particle·cm^{-2}·sec^{-1}·ster^{-1}, respectively. Author

N65-15444 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOME RESULTS OBTAINED IN THE MEASUREMENT OF EAST-WEST ASYMMETRY IN THE INTENSITY OF PRIMARY COSMIC RADIATION

Yu. G. Shafer, V. D. Sokolov, N. G. Skryabin, S. K. Dergeym, and R. B. Salimzibarov *In its* Cosmic Res. 13 Jan. 1965 p 194–198 refs (See N65-15432 06-30)

A brief description is presented of the experimental installation employed to measure the effect of the east–west asymmetry in cosmic radiation. The measurements were carried out within an altitude interval of 100 to 500 km. The lower boundary of albedo particle intensity and the effect of the east–west asymmetry of primary cosmic radiation were determined from the data of the experiment. Author

N65-15448 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE INTERACTION OF STREAMS OF RAREFIED PLASMA WITH THE MAGNETIC FIELDS OF OBJECTS IN SPACE

Yu. S. Sigov *In its* Cosmic Res. 13 Jan. 1965 p 221–227 refs (See N65-15432 06-30)

Several results from numerical solutions for the steady-state problem on the structure of the plane boundary layer between a magnetic field and a rarefied plasma are presented. The system of noncolliding charged particles in the self-matched electromagnetic field is described by a relativistic kinetic equation for the particle distribution function, while nonlinear equations were used for the self-matched field in the boundary layer. Spatial distribution of the basic physical quantities in nondimensional form, typical for a plane boundary layer, is also determined. Detailed mathematical formulation is given and the resultant discussion presented in relativistic-invariant form. M.G.J.

N65-15482* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

VELOCITY DEPENDENCE AND SOURCE SPECTRA OF SOLAR PROTON EVENTS

Frank B. Mc Donald *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. A Aug. 1964 11 p refs (See N65-15480 06-13) OTS: HC $5.00/MF $1.00

Solar particle events consisting of radiation with energy above 1 MeV are grouped into four distinct classes, depending upon the way in which the particles are transported. The first two classes consist of particles that arrive at the earth in a manner determined by particle velocity, the first arrive after a nearly direct transit, and the second after a diffusive propagation. The third class consists of particles that arrive in a manner determined by the motion of enhanced solar plasma. The fourth class consists of those that depend upon the rotation of the sun. It is shown how the velocity dependence of one of these modes of propagation makes it possible to determine the energy spectrum of the particles at the time of release from the sun. R.E.S.

N65-15490* Naval Research Lab., Washington, D.C.

SOLAR AND STELLAR RADIATIONS ABOVE THE EARTH'S ATMOSPHERE

Talbot A. Chubb *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. B Aug. 1964 48 p (See N65-15488 06-31) OTS: HC $6.00/MF $1.50

Recent data on solar and stellar radiation measurements made with rocket and satellite borne instruments is summarized. A study of plage areas and solar emission lines indicated that most of the sun's X-ray emission is line emission rather than continuum. X-ray increases were recorded for solar events, indicating that solar X-rays were responsible for radio fadeouts. A study of this type of data during flares provides a basis for a study of the temperature history of very hot flare-produced regions, and a determination of the source strength. Other X-ray studies show the existence of one relatively strong X-ray source in Scorpio and a weaker source in the Crab Nebula. R.E.S.

N65-15492* High Altitude Observatory, Boulder, Colo.

SOLAR FLARES AND THE ASSOCIATED EJECTION OF PARTICLES

Einer Tandberg-Hanssen *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. B Aug. 1964 9 p (See N65-15488 06-31) OTS: HC $6.00/MF $1.50

Of the main sources of extraterrestrial hazards to manned satellites, the solar flare phenomenon is perhaps the least understood. Great flares may emit both hard X-rays and relativistic particles that can be potential dangers to space travelers, as well as to sensitive equipment. We have some forecasting ability in the case of flares, but much more is desired, both from a practical point of view as well as for purely theoretical reasons. Further progress is not likely before a better understanding of the physics of the flare phenomenon is obtained. Even though there can be little doubt that the physics of flares is intimately linked to the presence of strong magnetic fields in neighboring sunspots, an acceptable theoretical explanation for the formation of flares is not available now. Author

N65-15635# Atomic Energy of Canada Ltd., Chalk River, Ontario. Deep River Lab.

TRAJECTORY-COMPUTED VERTICAL THRESHOLD RIGIDITIES FOR 85 NEUTRON MONITOR STATIONS

M. Kodama Nov. 1964 38 p refs (CRGP-1208; AECL-2134) Available from Atomic Energy of Canada, Chalk River: $1.00

As an extension of the trajectory calculations for asymptotic directions of cosmic ray particles done by Hatton and Carswell (1963), the vertical threshold rigidities for 85 cosmic ray stations were determined with an accuracy of 0.1 GV. It is shown that the differences of the new threshold rigidities from those of Quenby and Wenk are not negligibly small for particular stations, and also they are fairly sensitive to the difference of the geomagnetic field simulation adopted for the computation. The new

values are evaluated by applying them to typical cosmic ray disturbance events throughout the last solar cycles; namely a Forbush decrease in July 1959 and two solar flare particle increases in February 1956 and November 1960. Author

N65-15714# Library of Congress, Washington, D.C. Aerospace Information Div.
PHENOMENA IN THE UPPER ATMOSPHERE. COMPILATION OF ABSTRACTS Surveys of Soviet-bloc Scientific and Technical Literature
12 May 1964 20 p refs
(AID-P-64-34) OTS: HC $1.00/MF $0.50

Abstracts of reports concerning solar radiation and the ionosphere include those on the magnetic field in sunspot regions, ionization of the night atmosphere, chemical composition of the solar atmosphere, and nuclear processes in chromospheric flares. One report on Van Allen belts and cosmic rays is included that deals with corpuscular streams causing the diurnal cosmic ray effect. In the field of atmospheric electricity, reports on the structure of the atmospheric electric field, electrical processes during cloud development and precipitation, fog electricity, and electricity during thunderstorms are reviewed. An abstract of a report on argon ionization in the upper atmosphere is also included. D.S.G.

N65-15740*# National Aeronautics and Space Administration, Washington, D.C.
ARTIFICIAL EARTH SATELLITES, NO. 6, 1961
K. I. Gringauz, V. V. Bezrukikh, V. D. Ozerov, and R. Ye. Rybchinskiy [1961] 36 p refs Transl. into ENGLISH from Iskusstv. Sputniki Zemli (Moscow), no. 6, 1961 p 63–107
(NASA-TT-F-8045) OTS: HC $2.00/MF $0.50

CONTENTS:

1. RESULTS OF MEASUREMENTS OF POSITIVE ION CONCENTRATIONS IN THE IONOSPHERE BY MEANS OF ION TRAPS ON THE THIRD SOVIET EARTH SATELLITE K. I. Gringauz, V. V. Bezrukikh, and V. D. Ozerov p 1–29 refs

2. STUDY OF THE INTERPLANETARY IONIZED GAS, HIGH ENERGY ELECTRONS AND SOLAR CORPUSCULAR RADIATION BY MEANS OF 3-ELECTRODE TRAPS FOR CHARGED PARTICLES ON THE SECOND SOVIET COSMIC ROCKET K. I. Gringauz, V. V. Bezrukikh, V. D. Ozerov, and R. Ye. Rybchinskiy p 30–33 refs

N65-15818*# RAND Corp., Santa Monica, Calif.
CONCERNING ALPHA AT SEVEN EARTH RADII
E. C. Ray Jan. 1965 11 p refs
(Contract NASr-21(05))
(NASA-CR-60508; RM-4441-NASA) OTS: HC $1.00/MF $0.50

It is shown, by a numerical example, that for trapped radiation the addition of a solar-wind cavity field introduces no complications that are quantitatively important for L values less than about 7 earth radii. The nature of the small numerical effect that is present at L = 7 makes it virtually certain that at significantly higher latitudes the approximate integral as known at present will fail significantly. A program is underway to calculate a correction term for the integral, in case the particle in question is trapped. Author

N65-15819*# High Altitude Observatory, Boulder, Colo.
A BIBLIOGRAPHY ON THE EFFECTS OF SHORT-WAVE AND PARTICLE RADIATION ON GLASSES Astrogeophysical Memorandum No. 164
Lorne Avery 30 Jul. 1964 9 p refs
(Grant NsG-404)
(NASA-CR-60407) OTS: HC $1.00/MF $0.50

An annotated bibliography is presented of literature available in the High Altitude Observatory. It covers material pertinent to studies on the extent to which the presence of ultraviolet radiation, X-rays, and cosmic rays induces fluorescence, thermoluminescence, scintillation, and solarization of the optical elements of an orbital coronagraph. R.L.K.

N65-15890*# National Aeronautics and Space Administration, Washington, D.C.
IONOSPHERIC ANOMALIES AS AN INDICATOR OF IONIZING RADIATION OF THE CORPUSCULAR CLOUD AFTER A SOLAR CHROMOSPHERIC FLARE [IONOSFERNYYE ANOMALII KAK INDIKATOR IONIZIRUYUSHCHEGO IZLUCHENIYA KORPUSKULYARNOGO OBLAKA POSLE SOLNECHNOY KHROMOSFERNOY VSPYSHKI]
G. Nesterov, L. Krzhivski, and V. Letfus [1964] 7 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 6, 1964 p 1059–1063
(NASA-TT-F-9635; ST-AI-SP-10276) OTS: HC $1.00/MF $0.50

A strong increase of the sun's radio emission was noted in the decimeter and meter bands after the 2^+ chromospheric flare, observed on 16 September 1963 at the Ondrzheyov observatory. At the same time, an increase of cosmic radio noise and of atmospheric interferences, in the frequencies of 29 Mc and 27 kc, respectively, was also observed. To explain this, several hypotheses were proposed. The nature of the phenomena taking place after the flare was investigated according to the data of ionosphere absorption of long, medium, and short waves obtained for the same period in Sofia. Author

N65-16003# Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
SOLAR X RAYS FROM 3 TO 12 ANGSTROMS AS MEASURED WITH A PROPORTIONAL COUNTER SPECTROMETER
James E. Manson Nov. 1964 42 p refs *Its* Environ. Res. Papers No. 68
(AFCRL-64-932; AD-610220)

A sealed proportional counter with a 1.1-mg cm^{-2} window was used with a five-step integral pulse-height analyzer to measure the X-ray flux from the quiet sun. The instrument was flown on an Aerobee sounding rocket from White Sands Missile Range, New Mexico, on October 25, 1962 and May 2, 1963. A description of the construction and calibration of the equipment is given, and a detailed discussion of the interpretation of the data is presented. The resulting spectrum, if interpreted as a bremsstrahlung continuum, is characterized by a 3.5 million degree electron temperature, and has an intensity at earth distance of 1.2×10^{-4} erg $cm^{-2} sec^{-1}$ shorter than 8A, and 2.5×10^{-3} erg cm^{-2} sec^{-1} between 8 and 20A. Author

N65-16004# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
VERY LOW FREQUENCY ENVELOPE SPECTRA OF SOLAR RADIO BURSTS
Santimay Basu Nov. 1964 37 p refs *Its* Environ. Res. Papers No. 71
(AFCRL-64-941; AD-609861)

The nature of amplitude fluctuation in solar radio bursts was studied. The very-low-frequency envelope spectra of radio noise from the quiet sun is uniform which conforms theoretically to gaussian noise and experimentally to a laboratory

noise source. Type I solar bursts are characterized by broadband enhancement in the envelope spectra, while Type II and III solar bursts depict narrowband regions of high spectral intensity in the envelope spectra. Type IV bursts yield a uniform spectra with narrow bands of attenuation. An explanation of the above in the case of Types I, II, and III solar bursts is attempted by considering space charge wave amplification in the solar corona and assuming that the stream velocity has a very-low-frequency modulation. Author

N65-16054# Kiruna Geophysical Observatory (Sweden).
BALLOON-BORNE MEASUREMENTS OF SOLAR IONIZING RADIATION Annual Summary Report No. 1, 1 Jul. 1962–30 Jun. 1964
W. Reidler 31 Aug. 1964 41 p ref
(Contract AF 61(052)-604)
(AFCRL-64-868; AD-610253)

Reported are studies of solar ionizing radiation (X-rays and charged particles) at balloon altitudes by means of single GM-counters, threefold GM counter telescopes, ionization chambers, and scintillation counters. Author

N65-16062# American Science and Engineering, Inc., Cambridge, Mass.
A PROGRAM OF RESEARCH FOR THE MEASUREMENT OF COSMIC X-RAYS FROM ROCKET-BORNE INSTRUMENTATION Final Report
R. Giacconi, H. Gursky, and T. Quinn, Jr. 28 Oct. 1964 109 p refs
(Contract AF 19(628)-1605)
(ASE-758; AFCRL-64-888; AD-610154)

Rocket experiments were flown during October 1962 and June 1963 that confirmed the existence of substantial fluxes of soft X-rays in the night sky apparently of galactic origin. There is evidence for more than one distinct source as well as for a background of X-rays. The X-ray detectors used in these experiments consisted of Geiger counters sensitive in the 2 to 8 Å range and scintillation counters sensitive in the 0.1 to 1 Å range. An additional rocket payload was developed to measure X-ray emission from the moon extending to 44 Å. This payload involved a novel detection scheme that made use of the external photo effect on alkali halide surfaces. Author

N65-16117# Mitre Corp., Bedford, Mass.
UNCERTAINTIES IN SATELLITE POSITION DUE TO SOLAR RADIATION PRESSURE EFFECTS
R. W. Jacobus Bedford, Mass., AFSC, Electron. Systems Div. Nov. 1964 26 p refs
(Contract AF 19(628)-2390)
(TM-03993; ESD-TDR-64-147; AD-608652)

A simple formula for calculating the magnitude of solar radiation pressure is given, and the uncertainty in each of the terms is discussed. Worst-case positional deviations due to solar radiation pressure are calculated for one satellite pass under several sets of conditions. Complicating factors, such as earth shadow, body motion and reflected radiation, are discussed, and finally the net worst-case uncertainties in predicted satellite position after one pass are estimated. Author

N65-16310*# Consultants and Designers, Inc., Arlington, Va.
EXPERIMENTAL CONSEQUENCE PREDICTABLE FROM THE HAYAKAWA HYPOTHESIS ON THE ORIGIN OF PRIMARY COSMIC PHOTONS OF EXTREME ENERGY [CONSEQUENCES EXPERIMENTALES PREVISIBLES DE L'HYPOTHESE DE HAYAKAWA SUR L'ORIGINE DES PHOTONS COSMIQUES PRIMAIRES D'ENERGIE EXTREME]
Jerzy Wdowczyk 9 Feb. 1965 5 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 259, no. 8, 9 Nov. 1964 p 3227–3228
(Contract NAS5-3760)
(NASA-TT-F-9639; ST-CR-10290) OTS: HC $1.00/MF $0.50

Shown are the experimental consequences predictable from the Hayakawa hypothesis concerning the production of a neutral π-meson in the course of interaction in extragalactic space of a cosmic proton of extreme energy with a luminous photon. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-15432# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COSMIC RESEARCH
13 Jan. 1965 232 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 2, no. 6, 1964 p 817–956
(FTD-TT-64-1316/1+2; AD-610053)

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2. INVESTIGATION OF ONE CLASS OF TRAJECTORIES OF THE BOUNDED THREE-BODY PROBLEM M. L. Lidov, D. Ye. Okhotsimskiy, and N. M. Teslenko p 40–55 (See N65-15434 06-30)

3. SPHERES OF INFLUENCE OF THE MAJOR PLANETS AND THE MOON M. D. Kislik p 56–65 refs (See N65-15435 06-30)

4. ON SOLUTION OF THE THREE-DIMENSIONAL PROBLEM OF HELIOCENTRIC INTERPLANETARY FLIGHT WITH A CONSTANT-POWER ENGINE USING THE METHOD OF QUICKEST DESCENT S. A. Pokrovskaya p 66–74 refs (See N65-15436 06-30)

5. THE INFORMATION OF IONS IN THE IONOSPHERE A. D. Danilov p 75–101 refs (See N65-15437 06-13)

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7. THE CORRELATION BETWEEN THE RESULTS OF OBSERVATIONS OF THE EARTH'S THERMAL RADIATION AS A FUNCTION OF THE PROPERTIES OF THE INSTRUMENT USED V. A. Baryshev p 135–147 refs (See N65-15439 06-13)

8. THE DENSITY OF THE UPPER ATMOSPHERE DURING THE YEARS OF MINIMUM SOLAR ACTIVITY M. Ya. Marov p 148–163 refs (See N65-15440 06-13)

9. MEASUREMENT OF ATMOSPHERIC DENSITY IN THE ALTITUDE INTERVAL BETWEEN 50 AND 70 km Yu. A. Bragin p 164–169 refs (See N65-15441 06-13)

10. THE IMAGE OF THE SUN IN THE DISTANT ULTRAVIOLET REGION OF THE SPECTRUM I. A. Zhitnik, V. V. Krutov, L. P. Malyavkin, and S. L. Mandel'shtam p 170–184 refs (See N65-15442 06-29)

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14. COMBINED EFFECT OF LOW-FREQUENCY VIBRATION AND X-RAYS ON MAMMALIAN BONE-MARROW CELLS Yu. S. Demin p 205–216 refs (See N65-15446 06-04)

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16. THE INTERACTION OF STREAMS OF RAREFIED PLASMA WITH THE MAGNETIC FIELDS OF OBJECTS IN SPACE Yu. S. Sigov p 221–227 refs (See N65-15448 06-29)

N65-15433 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF MOTION IN A CENTRAL FIELD UNDER THE INFLUENCE OF A CONSTANT TANGENTIAL ACCELERATION

D. Ye. Okhotsimskiy *In its* Cosmic Res. 13 Jan. 1965 p 1–39 refs (See N65-15432 06-30)

A method is given for calculating motion in a central field under the influence of a tangential acceleration of constant magnitude. The range of velocities from circular to hyperbolic is considered. Asymptotic expansions are constructed near the attracting center and remote from it. It is shown that for the problem of acceleration from any initial circular orbit to any speed, and also for the problem of deceleration in the approach to a planet, an evaluation of the energy used can be obtained in approximation by means of a table with one entry for the dimensionless parameters. Author

N65-15434 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF ONE CLASS OF TRAJECTORIES OF THE BOUNDED THREE-BODY PROBLEM

M. L. Lidov, D. Ye. Okhotsimskiy, and N. M. Teslenko *In its* Cosmic Res. 13 Jan. 1965 p 40–55 (See N65-15432 06-30)

The motion of a space vehicle in the gravitational field of the earth and moon is studied. A class of orbits passing near the moon and experiencing strong perturbation due to the lunar gravitation is considered. The dependence of the geocentric parameters of the orbit after the encounter with the moon on certain initial parameters and on the parameters that determine the nature of the passage by the moon is investigated. The results of calculations are presented. Certain relationships that are of importance from the standpoint of the possibility of selecting orbits with specified properties in the bounded three-value problem are established. Author

N65-15435 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SPHERES OF INFLUENCE OF THE MAJOR PLANETS AND THE MOON

M. D. Kislik *In its* Cosmic Res. 13 Jan. 1965 p 56–65 refs (See N65-15432 06-30)

The concept of the sphere-of-influence of a small body with respect to a large one is introduced. It is shown that the use of spheres-of-influence instead of spheres-of-action in approximate calculations of artificial celestial-body trajectories results in improved accuracy. Author

N65-15436 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON SOLUTION OF THE THREE-DIMENSIONAL PROBLEM OF HELIOCENTRIC INTERPLANETARY FLIGHT WITH A CONSTANT-POWER ENGINE USING THE METHOD OF QUICKEST DESCENT

S. A. Pokrovskaya *In its* Cosmic Res. 13 Jan. 1965 p 66–74 refs (See N65-15432 06-30)

Acceleration programs and the trajectories corresponding to them that are optimum in the sense of minimizing

$$I = \int_0^T a^2(t)dt,$$

where a(t) is the thrust acceleration and T is the time of the flight, are determined in the three-body problem of interplanetary flight. The variational problem is solved by the method of quickest descent. Numerical results are presented for the case of earth-to-planet-to-earth flights with the terminal velocities made equal. Author

N65-15481* National Aeronautics and Space Administration, Washington, D.C.

AFTER NOW, WHAT THEN IN SPACE?

Homer E. Newell *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. A Aug. 1964 14 p (See N65-15480 06-13) OTS: HC $5.00/MF $1.00

A discussion is presented on the relationship of the accomplishments of past and current activities in space, and the capabilities offered for future investigations and studies in space science. Because of techniques developed in the investigations of the earth, its gravitational field, and its atmosphere, similar studies of planets can be instigated. Three different approaches for investigations are proposed: (1) a study of the vicinity of the sun and its surface; (2) a study out from the sun toward the interstellar medium; and (3) a study of the magnetospheres of other planets and their relationship to the sun and interplanetary medium. Life in space has become a possibility and is most important philosophically. Astronomy offers the most exciting opportunities because of the extensive range of wavelength study made possible with the improvement of satellites in relation to gamma rays, X-rays, ultraviolet light, infrared, and radio waves. Finally, controlled experiments in space can shed further light on the fundamental nature of the universe, conceivably leading to entirely new concepts. R.E.S.

N65-15485* Boston U., Mass.
THE METEOR POPULATION
Gerald S. Hawkins *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. A Aug. 1964 17 p (See N65-15480 06-13) OTS: HC $5.00/MF $1.00

Characteristics of the various groups in the meteor population are described. It has been made possible to draw a monotonic curve over the entire range from micrometeorites to meteorites. Average-sized meteorites are usually stone; large ones are usually iron. The mass distribution yields information concerning the origin, degree of crushing, and the number of asteroids crossing the orbit of the earth. Most masses of less than 100 gm. can be considered to have been ejected from the nucleus of a comet. These meteors are found to be extremely fragile, have low density and low crushing strength, and show seasonal variations in flux. Another group, the toroidal group, probably formed from the planet Jupiter, show movement in orbits of low eccentricity and high inclination. Micrometeorites show a crystal pattern when vaporized in the electron beam; and show the presence of minerals. The results of the studies can be used to estimate damage that might be sustained by spacecraft by calculating the probability of collision. R.E.S.

N65-15489* National Aeronautics and Space Administration, Washington, D.C.
THE ORBITING ASTRONOMICAL OBSERVATORY AND THE ORBITING SOLAR OBSERVATORY
Nancy G. Roman *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. B Aug. 1964 13 p (See N65-15488 06-31) OTS: HC $6.00/MF $1.00

An orbiting solar observatory designed to observe the sun, planets, and galaxies was constructed with special instruments, such as the X-ray spectrometer to scan the sun's spectrum, an X-ray ion chamber for measurement of intensity of X-ray emission, and an X-ray chamber for observation of microflares at times of solar activity. The observatory is undergoing improvement for still better observations. An orbiting astronomical observatory for the study of stars and other celestial objects from beyond the earth's atmosphere was also designed, and it will carry many astronomical instruments. Both observatories will be directed by ground command, and the results will be fed into a computer. R.E.S.

N65-15491* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE ATMOSPHERE AND SURFACE FEATURES OF MARS
Hyron Spinrad *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. B. Aug. 1964 20 p refs (See N65-15488 06-31) OTS: HC $6.00/MF $1.50

A review is presented of earthbound observations of Mars. An up-to-date description of the Martian surface is included, and it covers discussions of polar caps, dark areas, vibration absorptions in the infrared spectrum, color, mountain areas, canals, wave of darkening, propagation velocity, surface temperature, and the equatorial temperature. The molecular atmosphere of Mars reveals only two positively identified gases—carbon dioxide and water vapor. A study of the estimates of these gases is presented. The cloud and blue haze patterns are discussed in terms of absorption with photometric evidence. R.E.S.

N65-15500* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A REVIEW OF KNOWLEDGE ACQUIRED FROM THE FIRST MANNED SATELLITE PROGRAM
Christopher C. Kraft, Jr. *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. C. Aug. 1964 15 p (See N65-15497 06-31) OTS: HC $5.00/MF $1.00

The review of the Mercury program differentiates between the scientific knowledge and the philosophical knowledge obtained. The knowledge of size, shape, and design of equipment for spacecraft is reviewed. The design philosophy includes a study of just how great a part man could play in the automation of the spacecraft. Results of aeromedical and scientific experiments show that man can function in space to the point of backing up the automatic equipment in times of malfunction. Man is the deciding element, even though the automatic systems have to be precision designed. R.E.S.

N65-15609*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A PARAMETRIC STUDY OF MASS-RATIO AND TRAJECTORY FACTORS IN FAST MANNED MARS MISSIONS
Duane W. Dugan Washington, NASA, Feb. 1965 78 p refs (NASA-TN-D-2225) OTS: HC $3.00/MF $0.75

A parametric study was made of several factors that affect the magnitude of the gross-payload fractions for manned Mars missions of total duration less than one synodic period of Mars. Velocity requirements were found and used to determine the best possible ratios of gross payload to initial mass in a near-Earth orbit. Several mission parameters were varied to assess their effects upon the gross-payload ratios. Included among the parameters studied were: date of opposition of Mars included within the mission period; type of mission mode; propulsion characteristics; date of arrival at Mars; length of stay time at Mars; delayed and premature departures from Mars and from correctly oriented orbits about Earth; total transit time; and the fraction of gross payload unloaded at various phases of the mission. Author

N65-15611*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ZERO-DENSITY COSMOLOGICAL MODELS AND THEIR APPLICABILITY TO THE OBSERVED UNIVERSE
Windsor L. Sherman Washington, NASA, Feb. 1965 36 p refs (NASA-TN-D-2601) OTS: HC $2.00/MF $0.50

A review of relativistic models of the universe and material relating to the cosmical constant showed that this term is a constant of integration, and should be retained as a necessary term in the field equations of general relativity. An analysis of the zero-density model universe, a model universe that neglects density effects but retains the effect of curvature and the cosmical constant, showed that closed-form expressions could be obtained for the luminosity distance and redshift-magnitude relation. It was found that under certain conditions, only small differences exist between the zero-density model universe and the finite-density model universe, which is physically close to the observed universe in composition but uniform in structure. It was concluded that, under certain conditions, the zero-density model universe offers a valuable tool for the analysis of observational data. The zero-density redshift-magnitude relation was used with observational data in a least-squares computing process to calculate new values of the accceleration parameter and the Hubble parameter. Author

N65-15706# Minnesota U., Minneapolis. Observatory
A SEARCH FOR FAINT BLUE STARS. XXXIII: PROPER MOTIONS FOR 148 PHL STARS. XXXIV: PROPER MOTIONS FOR 24 BLUE STARS IN ORION
Willem J. Luyten and Helen S. Hughes [1963] 11 p (Contract Nonr-1892(00)) (AD-419159)

To determine the luminosity of faint blue stars, measurements of proper motion were made for 148 stars that could be compared to available old plate material (generally going back to around 1900). All measures were reduced with linear formulas only, and the proper motions and their estimated mean errors were derived by plotting the data and graphically drawing the best fitting straight line through them. Motion measurements of some of the bluest stars in the Orion region were also made through plate comparison. Resulting data from both studies are presented in tabular form. M.G.J.

N65-15744*# Consultants and Designers, Inc., Arlington, Va.
ON THE OPTICAL PROPERTIES OF THE DUST CLOUD SURROUNDING THE EARTH [OB OPTICHESKIKH SVOYSTVAKH PYLEVOGO OBLAKA VOKRUG ZEMLI]
V. G. Fesenkov 3 Feb. 1965 10 p ref Transl. into ENGLISH from Astron. Zh. (USSR), v. 41, no. 6, 1964 p 1001–1006
(Contract NAS5-3760)
(NASA-TT-F-9637; ST-ID-OA-10286) OTS: HC $1.00/MF $0.50

The optical properties of the cosmic dust cloud surrounding the earth are discussed, with the assumption that the surfaces of equal density are ellipsoids of revolution relative to the ecliptic plane. The flattening of these ellipsoids increases gradually and is zero in the immediate vicinity of the earth. It is also assumed that the density decreases with the distance according to an exponential law. Essential differences are discerned in comparison with the zodiacal light. The computations are conducted in the assumption of a spherical scattering indicatrix, as well as of a purely dust indicatrix, derived from direct measurements.
Author

N65-15828# Rome U. (Italy).
CALCULATION OF THE EPHEMERIS OF THE SAN MARCO SATELLITE [IL CALCOLO DELLE EFFEMERIDI DEL SATELLITE SAN MARCO]
Severino Giorgi 1964 38 p refs in ITALIAN *Its* Atti del Centro Ricerche Aerospaziali No.2

Procedures for determining the ephemeris of the San Marco satellite by using the variation-of-parameters method in conjunction with an IBM computer, are described. P.F.E.

N65-15891*# Consultants and Designers, Inc., Arlington, Va.
FORMATION OF HYDROGEN AND He^4 IN THE UNIVERSE AT THE PRESTELLAR STAGE [OBRAZOVANIYE VODORODA I He^4 VO VSELENNOY NA DOZVEZDNOY STADII (V MODELI GAMOVA)]
Yu. N. Smirnov 4 Feb. 1965 10 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 41, no. 6, 1964 p 1084–1089
(Contract NAS5-3760)
(NASA-TT-F-9636; ST-IGA-10285) OTS: HC $1.00/MF $0.50

The formation of light elements (hydrogen, deuterium, tritium, He^3, He^4) in the universe at the prestellar stage was traced within the framework of the Gamow–Alfer–Herman–Hayashi theory, that is, the initial matter was a "hot" mixture of neutrons and protons. The following nuclear reactions were taken into account:

$$n + p \rightleftarrows d + \gamma,$$
$$d + d \rightarrow He^3 + n,$$
$$d + d \rightarrow t + p,$$
$$n \rightarrow p + e^- + \bar{\nu},$$
$$d + t \rightarrow He^4 + n,$$
$$He^3 + n \rightarrow t + p,$$
$$He^3 + d \rightarrow He^4 + p.$$

Computations showed that the concentration of light elements, which follows from the above theory, is in sharp contradiction with the present-day astrophysical data. Author

N65-15915*# California Inst. of Tech., Pasadena.
MAGNETIC MEASUREMENTS NEAR VENUS
Edward J. Smith, Leverett Davis, Jr., Paul J. Coleman, Jr., (Calif. U., Los Angeles), and Charles P. Sonett (NASA. Ames Res. Center) [1965] 30 p refs
(Contract NASw-6; Grants NsG-151-61; NsG-249-62)
(NASA-CR-60354) OTS: HC $2.00/MF $0.50

Mariner II magnetometer data are presented. No magnetic fields attributable to Venus were detected. An upper bound on the magnetic dipole moment of Venus M_V is estimated in several ways, subject to uncertainties regarding the dipole orientation and the nature of the interaction between the solar wind and the planetary field. Based only on Mariner not entering the Venus magnetosphere, the upper bound lies between 1/2 and 1/6 of M_E, the Earth's magnetic dipole moment. However, the absence of field fluctuations near Venus corresponding to the shell of disordered fields detected outside the Earth's magnetosphere by satellites and space probes shows that M_V is less than M_E by at least an order of magnitude and makes it probable that M_V is less than $M_E/20$. This result is consistent with qualitative predictions based on the dynamo theory of planetary fields. Author

N65-15989# Army Corps of Engineers, Washington, D.C. Army Map Service
INTEGRATION ORBITS FOR SATELLITES
Soren W. Henriksen Aug. 1964 70 p refs
(AMS-TR-47; AD-609287)

The differential equations of motion of a rigid body in the earth's gravity field and atmosphere are discussed, and a method for their solution by numerical integration is given. Also considered are algorithms for the mechanical syntheses of differential and integral equations, with the intention of eventually mechanizing the mathematics as well as the computation of such problems. There are numerous and extensive tables of function and coefficients included. Author

N65-16082# Naval Observatory, Washington, D.C.
OBSERVATIONS OF THE SUN, MOON, AND PLANETS SIX-INCH TRANSIT CIRCLE RESULTS Circular No. 103
A. N. Adams and D. K. Scott 9 Oct. 1964 63 p

A provisional tabulation of the positions of the sun, moon, and planets is presented. The observed positions are geocentric, and received the usual corrections for instrumental errors, refraction, diurnal aberration, parallax, and orbital motion. The FK3 system was used as a basis for computations. Explanations of computations for the tables are given. R.E.S.

N65-16083# Naval Observatory, Washington, D.C.
DURCHMUSTERUNG AND HENRY DRAPER NUMBERS OF ALBANY GENERAL CATALOG STARS Circular No. 104
Victoria Meiller 30 Oct. 1964 140 p

N65-16086*# Aerojet-General Corp., Azusa, Calif. Von Karman Center
SPACE ENVIRONMENT CRITERIA. SPACE ENVIRONMENT BIBLIOGRAPHY Semiannual Report, 1 Jul.–31 Dec. 1964

W. Jenisch, Jr. and D. Christensen 20 Jan. 1965 300 p refs *Its* Rept.-2979
(Contract NAS8-11285)
(NASA-CR-60469) OTS: HC $6.00/MF $1.50

This is a bibliography of documents that will be considered in providing an accurate definition of the space, lunar, and planetary environments as they affect flight mechanics and the aerodynamic aspects of space travel. Present knowledge of the space environment is quantitatively incomplete. Concepts and ideas develop and change rapidly, and continual updating of this bibliography is necessary to keep abreast of the ever-expanding understanding of the space environment. Each of the documents contained herein will be considered and analyzed; this bibliography will be revised and updated, and only the most pertinent documents will be listed in the final report. Author

N65-16127* Israel Program for Scientific Translations, Ltd., Jerusalem.
PHYSICAL CHARACTERISTICS OF COMETS
S. K. Vsekhsvyatskii 1964 601 p refs Transl. into ENGLISH of the book "Fizicheskie Kharakteristiki Komet" Moscow, Gos. Izd. Fiz.-Mat. Lit., 1958 Published for NASA and NSF
(NASA-TT-F-80; OTS-62-11031) OTS: HC $6.00/MF $3.00

This is a general source book with data for all observed apparitions in the comets described. Discussions are presented of the nature of comets as members of the solar system, the theories of their form, their physics and chemistry, their origin and evolution, and the relation between planetary processes and their formation. Cometary photometry and a statistical analysis of orbital elements and physical characteristics are also discussed. A catalog of cometary absolute magnitudes as listed by Baldet and Obaldia is given in tabular form and includes identification, information on passages, shape of passage, and photometric parameters. A concise account of the observations and characteristics for apparition is presented with references to the sources of the descriptions. R.E.S.

N65-16159# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THERMAL EFFECT ON THE ROTATIONAL PERIOD OF AN ARTIFICIAL SATELLITE
G. Colombo and P. Higbie 30 Nov. 1964 24 p refs
(SAO Special Rept.-166)

An accurate determination of the instantaneous orientation of the Explorer XI Satellite (γ-ray telescope) was very important for the analysis of the data from the main experiment. Many precise observations of the solar transit obtained by means of sun and earth aspect sensors were recorded by the MIT Cosmic-Ray Group. On some days, more than 60 observations of the phase angle were recorded with an accuracy in the orientation of the satellite axis. In particular, this observational material is useful for studying the short-periodic variation of the angular velocity. Author

N65-16218# Harvard Coll. Observatory, Cambridge, Mass.
INTERPLANETARY DEBRIS
Gerald S. Hawkins [1963] 45 p refs Prepared jointly with Smithsonian Astrophys. Obs.

Measurements of the flux of objects into the earth's atmosphere are discussed, and a graph is presented showing that the number of particles increases monotonically with decreasing mass. When the mass can be measured in kilograms, the object is invariably a solid piece of stone or iron and is known as a meteorite. Particles of 10^{-12} to 10^{2} grams are meteoroids that have been derived from the icy nucleus of a comet and disintegrate in the upper atmosphere. Micrometeorites at the lower mass limit (10^{-12}g) decelerate without destruction in the upper atmosphere and can be collected by high-altitude rockets or by retrieval from the surface of the earth. The characteristics of these various groups in the meteor population are described, and their probability of satellite damage is discussed. G.G.

N65-16235*# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MULTIDIMENSIONAL PARAMETER ESTIMATION FOR POINT MASS. RE-ENTRY TRAJECTORIES
H. Schneider and A. Warwas 1 Oct. 1964 5 p Addendum to Group Rept. 1964-49; see N65-11141 02-19
(AD-451072)

To improve procedures for estimating reentry trajectory parameters, actual radar range and angle data from reentry experiments and simulated noisy radar data generated from a reentry six-degree-of-freedom computer trajectory program were processed. As a result, a simplified method is given to supersede the seven-parameter estimation scheme previously presented. The new procedure appeared to converge rapidly to the final parameter estimates for segments of trajectory less than about five sec. Total computer execution time for four iterations was on the order of 4 sec, so the techniques appear to have good potentialities for real-time radar applications. M.G.J.

N65-16260*# Alabama U. Research Inst., Huntsville.
PARAMETER OPTIMIZATION Interim Report No. 4, 1 Jul.-30 Sep. 1964
Frederick J. Tischer 15 Oct. 1964 64 p ref
(Contract NAS8-5411)
(NASA-CR-60548) OTS: HC $2.00/MF $0.50

The results of a study of the application of minimum variance techniques for obtaining optimized orbital parameters are presented. The approach is based on iterative evaluation of the measurements for the orbit determination. The values of the obtained orbital parameters come closer to those of the true orbit with each additional measurement. At this iterative approach the estimated orbit consists of a sequence of orbital trajectory segments which, with each additional measurement, are closer to the true orbit. Each of the trajectory segments represents a section of an optimum orbit described by optimized parameters. The optimization is valid for the specific set of the preceding measurements. Orbit perturbations can be introduced for each orbital segment and taken into account. One of the phases of the mathematical approach is described in detail and is based on a generalized Newton-Raphson operator which yields in an iterative process the subsequent orbital parameters by operating on their preceding values. Formulations of the orbit determination described in the paper were converted into a computer program for the UNIVAC 1107. An example of the solution of a representative problem is shown. D.E.W.

N65-16264*# Geological Survey, Washington, D.C.
ASTROGEOLOGIC STUDIES: SUMMARY Annual Progress Report, Jul. 1, 1963–Jul. 1, 1964
Nov. 1964 35 p refs With map supplement
(NASA Order R-66)
(NASA-CR-60509) OTS: HC $2.00/MF $0.50

Reported are the summaries of three separate works on: (1) lunar and planetary investigations; (2) crater and solid-state investigations; and (3) cosmic chemistry and petrology. A map supplement is included. R.E.S.

N65-16265*# Geological Survey, Washington, D.C.
ASTROGEOLOGIC STUDIES. PART A: LUNAR AND PLANETARY INVESTIGATIONS Annual Progress Report, Jul. 1, 1963–Jul. 1, 1964
Nov. 1964 144 p refs
(NASA ORDER R-66)
(NASA-CR-60510) OTS: HC $4.00/MF $1.00

These lunar and planetary investigations contain the preliminary results of detailed geologic mapping on a 1:1 000 000 scale of 5 new quadrangles in the equatorial belt of the moon. Several major stratigraphic units in the Imbrian and pre-Imbrian systems are described. Four papers discuss problems of origin and evolution of various types of craters and features associated with the craters such as rilles and rays. As a part of the lunar geologic investigations, detailed studies of the infrared emission and reflected visible radiation from the moon are in progress; a description of a systematic program of photoelectric and photographic photometry and the relation of the visible lunar photometric function to the infrared emission are given. Author

N65-16314*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE SYNTHESIS OF METEOROID DISTRIBUTIONS FROM MONOENERGETIC MONODIRECTIONAL KERNELS
R.D. Shelton, H. E. Stern, J. J. Wright, and D. P. Hale Washington, NASA, Feb. 1965 36 p refs
(NASA-TN-D-2630) OTS: HC $2.00/MF $0.50

A general method for calculation of the meteoric flux at any finite point, given an arbitrary spectrum at infinity of broad meteoric streams, is derived. This formalism is explicitly applied, obtaining plots of relative flux versus angle for a series of examples dealing with monoenergetic isotropic distributions and transformed isotropic cases—that is, apparent flux as seen about an attractive center (for example, earth) moving relative to a system in which the distribution is isotropic at infinity. A mathematical appendix outlining the computational methods employed is included. Author

N65-16318*# California U., La Jolla.
CHEMICAL EVIDENCE RELATIVE TO THE ORIGIN OF THE SOLAR SYSTEM
Harold C. Urey [1964] 47 p refs Presented at the Natl. Acad. of Sci. Meeting, Washington, D.C., 29 Apr. 1964 Submitted for Publication
(Grant NsG-323)
(NASA-CR-60567) OTS: HC $2.00/MF $0.50

Chemical and physical evidence for the origin of various features of meteorites and of the planetary system, together with evidence and arguments from different disciplines, are presented in this appraisal of various theories. Rebuttals of some viewpoints were based on the following evidence: (1) variation in density of the planets and moon, and differences in composition of meteorites, terrestrial planets, and the sun; (2) indications that iron meteorites are fragments of small objects and not cores of planetary objects, resulting from internal radioactive heating; (3) evidence that some diamonds in meteorites apparently were made under high steady pressures. M.G.J.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-15488*# Virginia Polytechnic Inst., Blacksburg.
CONFERENCE ON ARTIFICIAL SATELLITES, PART B
Aug. 1964 295 p refs Conf. held at Va. Polytech. Inst., Blacksburg, 12–16 Aug. 1963 *Its* Bull., Eng. Expt. Sta. Ser. No. 156, Vol. 57, No. 8
(Contract NASr-226)
(NASA-CR-60132) OTS: HC $6.00/MF $1.50

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3. THE ATMOSPHERE AND SURFACE FEATURES OF MARS H. Spinrad (JPL) 20 p refs (See N65-15491 06-30)

4. SOLAR FLARES AND THE ASSOCIATED EJECTION OF PARTICLES E. Tandberg-Hanssen (High Altitude Observatory) 9 p (See N65-15492 06-29)

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5. TIROS — THE FIRST METEOROLOGICAL SATELLITE R. M. Rados (NASA, Goddard Space Flight Center) 55 p (See N65-15493 06-31)

6. THE NIMBUS SPACECRAFT SYSTEM H. Press (NASA, Goddard Space Flight Center) 61 p (See N65-15494 06-31)

7. PASSIVE COMMUNICATIONS SATELLITES W. J. O'Sullivan, Jr. (NASA, Langley Res. Center) 49 p ref (See N65-15495 06-31)

8. ACTIVE COMMUNICATION SATELLITE SYSTEM D. Mitchell (Bell Telephone Labs.) 31 p (See N65-15496 06-31)

N65-15493* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TIROS—THE FIRST METEOROLOGICAL SATELLITE
Robert M. Rados *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. B Aug. 1964 55 p (See N65-15488 06-31)
OTS: HC $6.00/MF $1.50

A description of the Tiros system and some of the results are summarized. Four systems make up the Tiros program: (1) the spacecraft which observes the earth and transmits data; (2) the three-stage Delta launch vehicle; (3) the ground stations used to command and control the satellite and to acquire data; and (4) the data utilization system, which distributes meteorological information. The Tiros spacecraft includes television subsystems, an infrared subsystem to detect the earth's emitted and reflected radiation, associated transmitters and receivers for command and data handling, and a control and telemetry circuitry. A table and a description of the results of the seven Tiros satellites are included. R.E.S.

N65-15494* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE NIMBUS SPACECRAFT SYSTEM
Harry Press *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. B Aug. 1964 61 p (See N65-15488 06-31) OTS: HC $6.00/MF $1.50

A comparison of the Tiros and Nimbus satellite systems is presented. The fundamental criteria and conditions for the Nimbus spacecraft design are discussed, as are the characteristics and major subsystems, including timing systems, the sensory system, and operational ground stations for data control. Some of the problems encountered in its development, and a report on the current status of the program are included. The results of the initial development are listed, as well as the basic spacecraft construction, including the following meteorological sensors: AVCS, APT, MRIR, and HRIR. More refined basic subsystems are built into the structure. R.E.S.

N65-15495* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PASSIVE COMMUNICATIONS SATELLITES
William J. O'Sullivan, Jr. *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. B Aug. 1964 49 p ref (See N65-15488 06-31) OTS: HC $6.00/MF $1.50

A passive communications satellite provides the link between the satellites themselves and the ground transmitting and receiving stations. This study includes: (1) the physical characteristics of the passive system; (2) the basic transmission theory of communications satellites and the equations substantiating the theory; (3) a comparison of the characteristics and economics of passive and active communications satellite systems; and (4) a review of advanced concepts for the development of more accurate passive communications satellites, with application to Echo II. R.E.S.

N65-15496* Bell Telephone Labs., Murray Hill, N.J.
ACTIVE COMMUNICATION SATELLITE SYSTEMS
Doren Mitchell *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. B Aug. 1964 31 p (See N65-15488 06-31) OTS: HC $6.00/MF $1.50

Telstar experiments are discussed as an example of an active communications system. Medium-orbit and high-orbit systems are related to the engineering advantages of each. The high-orbit system with three 24-hour satellites is shown to require a simpler ground station network and to offer better coverage with fewer vehicles than the low-orbit system. The disadvantages of the high-orbit system are the circuit link delay and the problem of insertion into and maintenance of the 22 000 mile orbit. R.E.S.

N65-15497*# Virginia Polytechnic Inst., Blacksburg.
CONFERENCE ON ARTIFICIAL SATELLITES, PART C
Aug. 1964 157 p refs Conf. held at Va. Polytech. Inst., Blacksburg, 12–16 Aug. 1963 *Its* Bull., Eng. Expt. Sta. Ser. No. 156, Vol. 57, No. 8
(Contract NASr-226)
(NASA-CR-60131) OTS: HC $5.00/MF $1.00

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3. A REVIEW OF KNOWLEDGE ACQUIRED FROM THE FIRST MANNED SATELLITE PROGRAM C. C. Kraft, Jr. (NASA, Manned Spacecraft Center, Houston) 15 p (See N65-15500 06-30)

4. THE MANNED ORBITAL LABORATORY J. F. Shea and M. I. Yarymovych (NASA, Washington) 50 p (See N65-15501 06-31)

N65-15498* Radio Corp. of America, Princeton, N.J.
PROJECT RELAY
John D. Kiesling *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. C Aug. 1964 11 p (See N65-15497 06-31) OTS: HC $5.00/MF $1.00

The communications satellite Relay is described in terms of communication system, command, tracking, telemetry, power supply, stabilization, and attitude control. The objectives of the program were: (1) to investigate wideband communications between distant ground stations by low altitude orbiting satellite; (2) to measure the effects of the space environment on a satellite; (3) to develop operational experience in the use of such a system; (4) to measure radiation damage to critical components; and (5) to monitor radiation encountered at the orbital altitudes. About 2000 orbits were completed; and successful relay of television, telephone, and other data transmissions between North America and Europe and two-way telephone service between North and South America were also completed. The trouble spots have been with intermittent failure of a series power transistor; equipment sometimes turns on and off without command, and radiation effects on solar cells have been marked. R.E.S.

N65-15499* National Aeronautics and Space Administration, Washington, D.C.
SATELLITE DATA RECOVERY AND TRACKING SYSTEM
Gerald M. Truszynski *In* Va. Polytech. Inst. Conf. on Artificial Satellites, PT. C Aug. 1964 46 p (See N65-15497 06-31) OTS: HC $5.00/MF $1.00

The Mercury tracking and data acquisition system was evaluated in terms of mission requirements for projected Gemini flights. A prime objective was to meet a basic five-out-of-fifteen minute contact time, but certain compromises had to be met, with gaps resulting. Data acquisition and high speed near-real-time computations were critical functions. A world-wide ground communications link was accomplished. The computing centers are described. It was found that an orbit could be determined with good accuracy and that the astronaut played an important role in control. A continued need for daylight launch and recovery was proved. It was concluded that by extremely careful and detailed planning and with existing effective tracking and data acquisition facilities, Gemini flights will be possible. E.P.V.

N65-15501* National Aeronautics and Space Administration, Washington, D.C.
THE MANNED ORBITAL LABORATORY
Joseph F. Shea and Michael I. Yarymovych *In* Va. Polytech. Inst. Conf. on Artificial Satellites, Pt. C Aug. 1964 50 p refs (See N65-15497 06-31) OTS: HC $5.00/MF $1.00

The uses and the various possible design concepts of a Manned Orbital Laboratory (MOL) are discussed. The primary use of a MOL is the investigation of man's behavior and capabilities during prolonged space flight, leading to the decision whether artificial gravity is necessary in future advanced manned space vehicles. Secondary uses include development testing of numerous subsystems as well as

conducting a number of scientific experiments. The design concepts reviewed range from the minimum MOL, which is a modification of the Apollo spacecraft to accommodate 2 men for periods of 100 days, through the small MOL, which is a Saturn I or IB launched laboratory subsequently supplied with a 4- to 6-man crew, by means of a ferry vehicle, to the large MOL, which is an advanced type Saturn V launched laboratory, operating with a 12- to 24-man crew. In conjunction with the laboratory concepts the logistics systems, like modifications of Gemini, Apollo, or advanced new ballistic and lifting body reentry systems, are reviewed. Author

N65-15529*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SOLAR SIMULATION TESTING OF AN EARTH SATELLITE AT GODDARD SPACE FLIGHT CENTER

R. E. Bernier, R. H. Hoffman, A. R. Timmins, and E. I. Powers Washington, NASA, Jan. 1965 18 p refs Presented at the 1964 Tech. Meeting and Equipment Exposition, Philadelphia, 13-5 Apr. 1964

(NASA-TN-D-2614) OTS: HC $1.00/MF $0.50

The results are presented of a solar simulation test, as well as the testing techniques used, on the flight backup Ariel II(UK-2/S-52) international ionosphere satellite. The satellite was subjected to carbonarc solar simulation at 10^{-6} torr vacuum, with liquid-nitrogen shroud wall temperature. It was rotated at 3 rpm to simulate orbital spin, and was tested at several attitudes relative to the incident solar energy. The major objectives of the test were to operate the spacecraft under simulated dynamic space conditions, and to evaluate the spacecraft thermal design. The results verified the design and demonstrated successful operation of the spacecraft over the entire range of design temperatures and dynamic temperature changes. Author

N65-15561# Air Force Systems Command, Eglin AFB, Fla. Air Proving Ground Center

CHARACTERISTICS OF VERTICAL PROBE ROCKET VEHICLES

Carroll B. Butler and Robert J. Hostetler Jun. 1964 195 p Revision to APGC-TR-61-43

(APGC-TDR-64-37; APGC-TR-61-43; AD-444940)

Presented is an updated compilation of the available performance data and information regarding payloads, capabilities, dimensions, weights, and launcher requirements for vertical probe rocket vehicles. A listing of manufacturers of vehicles and rocket motors, information on launchers, and a method for estimating the cost of the vehicles are also provided. This information is presented for use in the planning phase of a program to enable a potential user of vertical probe rocket vehicles to determine the vehicles available, to estimate the funds required to obtain the vehicles, and to determine the sources of procurement for the vehicles. In addition, this report is intended to acquaint interested agencies with the overall capabilities of vertical probe rocket vehicles where new approaches or concepts of testing are required. Author

N65-15588*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ENVIRONMENTAL TEST PROGRAM OF THE BEACON EXPLORER SPACECRAFT

R. M. Tysdal Oct. 1964 40 p refs

(NASA-TM-X-55119; X-320 64-307) OTS: HC $2.00/MF $0.50

The primary problem areas during the test program were in the optimization of the thermal design affecting the batteries, and developing a thorough evaluation of the current limiter through environmental test conditions. Flight spacecraft II (SN 36) was launched from Cape Kennedy by Delta No. 24 on March 19, 1964, but failed to achieve orbit. In a launch from the Western Test Range on October 9, 1964, the Scout vehicle placed the Beacon Explorer into orbit. The satellite is functioning satisfactorily except that the base plate temperature is higher than expected in 100% sun which necessitates turning off the doppler beacons temporarily to keep internal temperatures down. However, the mission of the satellite is being fulfilled, and about November 12, 1964 when the spacecraft went out of 100% sunlight, the dopplers were turned on, and the spacecraft is now operating as planned. Author

N65-15593*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THERMAL DESIGN AND THERMAL DATA ANALYSIS OF SA-5 PAYLOAD

Tommy C. Bannister and Cliff L. Lumpkin Washington, NASA, Feb. 1965 26 p ref

(NASA-TN-D-2609) OTS: HC $2.00/MF $0.50

The SA-5 payload was injected into orbit on January 29, 1964. The payload consisted of the S-IV stage, the IU (instrument unit), the adaptor, and a Jupiter nose cone. Inside the adaptor was a beacon transmitter whose power was supplied by batteries located in the nose cone. Temperature specifications on the batteries and the transmitter required thermal control in orbit. The specifications were as follows: beacon transmitter range, -10° to 75° C; nose cone battery range, -20° to 75° C. The in-flight temperature measurements of these two components showed that the temperatures remained within the following ranges: beacon transmitter range, -4° to 13° C; nose cone battery range, 4° to 20° C. Presented in this report are the thermal requirement of the SA-5 payload, the thermal design, the flight data, and the postlaunch analysis. Author

N65-15625*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A FLIGHT INVESTIGATION OF THE SCOUT FOURTH-STAGE DIAPHRAGM SEPARATION DISTURBANCES

Seymour Salmirs Washington, NASA, Feb. 1965 19 p refs

(NASA-TN-D-2593) OTS: HC $1.00/MF $0.50

An investigation of the separation impulses of the Scout vehicle fourth-stage separation system was conducted during a flight of the ST-7 vehicle. Separation impulses were obtained from the measurement of the third- and fourth-stage motions and correlated with other ground investigations on the separation mechanism. Visual light scanners and accelerometers were used to obtain a record of the fourth-stage motion, and rate and attitude gyros gave information on the third-stage motion. The results showed that the impulse during the operation of the separation diaphragm was in good agreement with that measured in ground tests. However, the larger part of the flight-measured impulse occurred immediately following the actual separation of the stages. The total measured impulse was about 5.5 pound-seconds, or more than twice the maximum measured in ground tests. A resulting tipoff angle of 10° was encountered. The close proximity of the third and fourth stages during and following ignition was concluded to be the main cause of the tipoff impulse. Author

N65-15855*# National Aeronautics and Space Administration, Washington, D.C.
RANGERS C AND D: NASA READIES TWO RANGER SPACECRAFT FOR MOON MISSIONS News Release No. 65-25
4 Feb. 1965 51 p
Available from the Scientific and Technical Information Division

The National Aeronautics and Space Administration announces the launching of Rangers C and D, after February 17, 1965, for the purpose of gathering scientific information on the moon's surface, as well as topographical data for the Surveyor soft lander and the Apollo manned landing program. Each spacecraft will carry six television cameras that are able to provide more than 4000 high resolution photographs. The primary target areas will be close to the moon's shadow line. A detailed description of the Ranger's technical background, a Ranger fact sheet, and a mission analysis are presented. G.G.

N65-15945*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOUNDING ROCKETS
Eleanor C. Pressly et al Jan. 1965 136 p
(NASA-TM-X-55123; X-670-65-2)

The usefulness and performance of sounding rockets in space work is described. Sounding rockets are capable of investigating a vertical cross section of the atmosphere and provide ample observing time for experiments, which may be repeated if necessary. They are economical, of practical size, and have simple logistics and ground support systems. Sounding rockets are useful for synoptic work, and provide a good basis for accumulating data for further experiments. These rockets provide effective and economical means for the scientific investigation of space, and many countries are involved in programs or research using such rockets. Detailed descriptions and diagrams of the Aerobee, Astrobee 1500, Javelin, and Nike-Apache rockets are included. E.W.

N65-15994# Library of Congress, Washington, D.C. Aerospace Technology Div.
SPACECRAFT UTILIZING THE LIFTING REENTRY TECHNIQUE. PART I: REENTRY AND RECOVERY OF SOVIET MANNED SPACE VEHICLES Surveys of Soviet-Bloc Scientific and Technical Literature
29 Oct. 1964 87 p refs
(ATD-P-64-60; AD-608504)

Soviet aerospace literature is discussed and some conjectures and conclusions made about the details of their space program not presented in the literature. The recovery phase of Soviet flights is discussed in terms of reentry methods, thermal protection, and parachute landing systems. The other areas covered include: launching, spacecraft reliability, control systems, retroengine, spacecraft structure, heat shield, and landing systems. A final section discusses Soviet lunar flights. R.E.S.

N65-16227*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT REENTRY EXPERIMENTS
Herbert A. Wilson, Jr. and Robert L. Wright [1964] 39 p Presented at the Va. Polytech. Inst. Conf. on the Role of Simulation in Space Technol., Blacksburg, 17-21 Aug. 1964
(NASA-TM-X-54971) OTS: HC $2.00/MF $0.50

Various techniques are described that are used to simulate reentry conditions produced by different flight situations. Reentry flight conditions that can be simulated by "hot" and "cold" ground facilities are reviewed, and some of the current flight programs for obtaining data in the Apollo reentry envelope are discussed. The observed parameters are: (1) environment (heating); (2) materials response; (3) communication problems; and (4) observable phenomena. A discussion of the launch vehicles, the unknown parameters, and the methods of data acquisition for each program is presented. G.G.

N65-16296# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group
THE RELATIVE MOTIONS OF TWO INDEPENDENT COMMUNICATION SATELLITES Technical Documentary Report, Sep. 1962-Apr. 1964
Donald R. Shover Sep. 1964 84 p
(SEG-TDR-64-44; AD-608809)

This report presents a method of determining the relative positions of two independent communication satellites and the times during which these two satellites are in the proper positions for two specified modes of communication. The method developed is to be used in support of two separate satellite experiments to determine if communication is possible between two satellites, which are physically out of line of sight of each other, via bending and reflecting radio waves in and through the ionosphere. Presented is a mathematical model that determines the positions of two independent satellites as a function of time in the earth coordinate system in terms of colatitude, longitude, and altitude. Both satellites are tracked from their injection points throughout their orbits in finite-time increments for a preselected time. In conjunction with determining the positions of the satellites, the model also determines the time, with respect to some given time reference, when the satellites enter and leave the line of sight of any set of designated geographical positions as well as when the satellites enter and leave the line of sight of each other. The recorded times are summed, and the percentages of the recorded times, based on the total time considered, are determined. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-15455 Watertown Arsenal Labs., Mass. Army Materials Research Agency
COMMENTS ON THE STRENGTH OF REAL STRUCTURAL MATERIALS
Kenneth H. Abbott *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 93-97 refs (See N65-15451 06-19)

The methods of determining tensile strength and engineering yield strength are reviewed, and it is pointed out that strength is normally determined by the plastic properties of the metal and, per se, is not related to fracture. Further, the propagation of a crack from an existing defect can result in

fracture of the metal before any appreciable general plastic flow takes place, and can occur at a stress level well below the engineering yield strength. Therefore, the assumption that component failure always occurs when a particular strength is exceeded is invalid. D.S.G.

N65-15457 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PROBABILITY THAT STRESS IS LESS THAN STRENGTH AT PRESCRIBED CONFIDENCE LEVELS, FOR NORMALLY DISTRIBUTED DATA

E. L. Bombara *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 111–189 refs (See N65-15451 06-19)

This paper presents methods for estimating probability that stress does not exceed strength, with a prescribed level of confidence. Tables are provided to simplify calculations of such probabilities. Input data are the mean and standard deviation of operating stress from n_{ss} tests, and the mean and standard deviation of strength from n_{th} tests. Precision of these methods, based on approximate results by Welch and Aspin, is indicated vs sample sizes and ratios of variances. Comparisons of analytical results with computer simulations were made to illustrate the amount of bias of the method when the number of tests is very small; say, 5. Author

N65-15526*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

VIBRATION AND STABILITY ANALYSIS OF COMPRESSED ROCKET VEHICLES

Rudolf F. Glaser Washington, NASA, Jan. 1965 52 p refs (NASA-TN-D-2533) OTS: HC $3.00/MF $0.50

Because rocket vehicles are exposed to large axial loads caused by the thrust and the inertia forces of the vehicle masses, the stability problem is important. To ensure proper calculation of the critical load, the dynamic stability criterion must be applied. Such calculation requires the performance of a vibration analysis of the loaded system. The analysis developed in this report is a transfer-matrix method based on ordinary and Timoshenko's beam theory. To simplify the procedure, the vehicle was modeled by a lumped-mass system and was assumed to be longitudinally rigid. For convenience, damping was neglected, although it may play an important role in reducing the critical load imposed. To study the influence of mass and stiffness distribution, the analysis was applied to several characteristic cases. Finally, a Saturn V three-stage vehicle was investigated. However important the stability problem may be for highly accelerated missiles, this analysis indicated that for modern launch vehicles the acceleration is far removed from critical values. Author

N65-15527*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

DYNAMIC ANALYSIS OF A MULTI-LEGGED LUNAR LANDING VEHICLE TO DETERMINE STRUCTURAL LOADS DURING TOUCHDOWN

John Admire and Alden Mackey Washington, NASA, Jan. 1965 34 p

(NASA-TN-D-2582) OTS: HC $2.00/MF $0.50

Presented is a method of determining the structural loads of a multilegged lunar landing vehicle during touchdown. The stability of the vehicle is obtained as a fundamental aspect of the problem. The motion of the vehicle center of gravity is restricted to two dimensions; but the feet of the vehicle, while on the lunar surface, may move in any direction. The feet are connected to the body of the vehicle by deformable legs. These legs consist of an inverted tripod and a member from the tripod vertex to the foot. The ability of the feet to move in any direction while on the lunar surface is a significant improvement over a strictly two-dimensional analysis. A more accurate evaluation of the loads in the struts can be made and, therefore, the actual dynamics of the vehicle are better defined. The capability of this procedure to analyze the touchdown dynamics of a vehicle with any number of legs is also a significant advancement over the two-dimensional analysis. Author

N65-15632# Harvard U., Cambridge, Mass. Div. of Engineering and Applied Physics

STRESSES ABOUT A CIRCULAR HOLE IN A CYLINDRICAL SHELL

Peter Van Dyke Sep. 1964 61 p refs

(Contract Nonr-1866(02))

(TR-21; AD-608264) OTS: $3.00

The effects of a circular hole on the initial states of uniform stress produced by loading an infinite shallow cylindrical shell by axial tension, internal pressure, and torsion are determined. The linear equations for a thin, shallow cylindrical shell are reduced to a single complex differential equation involving the dimensionless curvature parameter β. The solution to this equation is written as an infinite series, and a numerical collocation procedure is used to obtain the stresses in the shell for values of β up to 4. Boundary-layer techniques are employed to obtain approximations of the stresses for large values of the parameter β. Author

N65-15800# United Aircraft Corp., East Hartford, Conn. Research Labs.

HYPERSONIC STATIC AND DYNAMIC STABILITY OF WING-FUSELAGE CONFIGURATIONS Final Technical Report

Martin R. Fink and James B. Carroll Jan. 1965 153 p refs

(Contract NOw-64-0092-f)

(C910188-17; AD-455340)

Equations for calculating hypersonic static and dynamic stability coefficients of wings and axisymmetric bodies, including the effects of the body flow-field on the wing, are derived from the shock-expansion method. Wind-tunnel data were obtained at a Mach number of 4.8 to show the effects of varying the fuselage forebody shape, afterbody length, wing planform, wing axial location, and diameter-to-span ratio. The calculated coefficients are compared with the wind-tunnel data and with those calculated by use of Newtonian theory and linearized supersonic theory. Author

N65-15845# McGill U., Montreal (Canada). Structures Lab.

INTERACTION OF SHOCK WAVES WITH BURIED STRUCTURES

J. O. Mc Cutcheon, R. N. Yong, and A. J. Reynolds Oct. 1964 26 p refs Presented at New York Structural Conf., Am. Soc. of Civil Engr., New York, 23 Oct. 1964 *Its* Appl. Mech. Ser. No. 5

(Grant DRB G-1601-19)

Presented is a report on the development of an experimental buried structural element of varying mass and on test results in the laboratory and in the field. The laboratory work used a falling weight apparatus to produce a wave in a granular medium, while the field measurements were concerned with a surface blast of 500 tons of TNT. The accelerations reported by the structural element do not vary linearly with mass but are modified by the displacements

of the structural element relative to the free field. The relationship between acceleration ratios and inverse mass ratios is not linear. The nonlinearity is thought to be due not only to relative masses but also to displacements relative to the granular medium. Author

N65-15851# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
STUDIES ON THE INSTABILITY OF CIRCULAR RINGS
Yaakov Elkon Jun. 1964 59 p refs
(Grant AF-AFOSR-63-347)
(ASRL-TR-119; AFOSR-64-1843; AD-609503)

Determined are the critical loads associated with the instability phenomenon of elastic-perfectly plastic circular rings, which are confined to a rigid boundary and are subjected to end circumferential compressive loads. Finite-deflection nonlinear theory is employed, and two types of imperfections are included in the model: (1) boundary imperfection; and (2) an imperfection in the shape of the ring in its initially stress-free state. Comparison with energy methods for the instability analysis is presented and discussed. It is shown that the critical loads are independent of energy considerations, and are related only to the magnitude of the imperfection and radius-to-thickness ratio. Author

N65-15928# Grumman Aircraft Engineering Corp., Bethpage, N.Y.
NON-LINEAR AXI-SYMMETRIC ANALYSIS OF SPHERICAL CAPS BY THE MATRIX FORCE METHOD
Jacob D. Rosenbaum Sep. 1964 21 p refs
(ADR-02-11-64-5)

This report presents the solution of a specific case of a clamped spherical cap, deformed axisymmetrically under uniform pressure. The solution for the simplified structural idealization selected provides a surprisingly good engineering approximation in the prebuckling region, and the predicted snap-through load is only about 5% higher than the corresponding theoretical result. The idealization used in this study is intended to be applicable also to future work on unsymmetric problems. As such, it is not an optimum configuration for the special case of axisymmetric loads and deformations considered here. The results obtained indicate that a relatively modest increase in the complexity of the idealization should lead to a satisfactory unsymmetrical solution. Author

N65-15957# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Inter-Range Instrumentation Group
METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME XXXIV: JUNE 1964 FIRINGS Data Report
Oct. 1964 152 p
(IRIG-109-62, Vol. XXXIV; AD-455000)

Reported are the wind and temperature measurements from all available Meteorological Rocket Network firings for June 1964, including the radiosonde observations nearest the time of firing, provided they are within ±6 hours. Since only those firings that yielded significant data are of interest here, the report does not include unsuccessful firings. The data included were derived from a total of 64 rocketsonde observations. The types of rockets and their temperature and wind sensor instrumentation systems are identified on the charts, and also by code on the corresponding data sheets. D.E.W.

N65-15979# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
LATE-STAGE EQUIVALENCE AND SIMILARITY THEORY FOR ONE-DIMENSIONAL IMPACTS
John K. Dienes 10 Nov. 1964 32 p refs Presented at the 7th Hypervelocity Impact Symp., Tampa, Fla., Nov. 1964 Submitted for Publication
(Contract DA-04-495-AMC-116(X))
(GA-5755; AD-608870)

Slabs impacting on a semi-infinite target are shown to induce a one-dimensional shock-wave system that can be described analytically if the target has a perfect-gas equation of state. The flow is of the similarity type at late times, and a hydrodynamic code example is used to demonstrate that flows not initially self-similar become so asymptotically. The exact solution for a perfect-gas equation of state whose ratio of specific heats is 7/5 is discussed, and it is shown that the product of energy and momentum for the flow is constant and equal to the product for the impacting slab. Therefore, all impacts with the same value of this product are equivalent at late times. The explanation of this result in terms of the free surface condition is shown. The solution for general specific-heat ratios is obtained by relating it to other one-dimensional analytical work. Author

N65-16019# J. G. Engineering Research Associates, Baltimore, Md.
RANDOM LOADING AND RADIATION FROM STIFFENED AND SANDWICH TYPE CYLINDRICAL SHELL STRUCTURES. PART II: UNSYMMETRICAL LOADING WITH KNOWN SPACE DISTRIBUTION
Joshua E. Greenspon Oct. 1964 12 p refs
(Contract Nonr-2733(00) FBM)
(TR-10; AD-609636)

This study of random loading and radiation from cylindrical shells treats the general loading on a cylindrical shell and the resulting radiation from the structure. The solution for known spatial distribution and random loading in time is given in detail. Author

N65-16048# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
BLAST LOADING TESTS OF CONICAL SHELLS
R. M. Cooper and A. F. Di Giacomo 24 Nov. 1964 76 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-260; TDR-469(5250-30)-3; AD-454615)

Low density shock tube tests were conducted on the blast loading of 6061-T6 aluminum. Damage (by shell buckling) was sustained by test specimens having a nominal wall thickness of 0.020 in., whereas no discernible damage was experienced by similar 0.030- or 0.060-in. wall test models. Nominal strain sensitivities to pressure were obtained for the three classes of test models. Certain strain records were also analyzed for frequency content, and significant response frequencies were related to the results of vibration tests of similar test models, in an attempt to identify the important response modes. Static buckling tests were carried out that gave nearly identical buckling results compared to those obtained by use of the shock tube for the 0.020-in. wall specimens. Author

N65-16098# David Taylor Model Basin, Washington, D.C.
AXISYMMETRIC COLLAPSE OF CIRCULAR CYLINDRICAL SHELLS
Masao Yoshiki, Yoshiyuki Yamamoto, and Tomio Suzuki Sep. 1964 34 p refs Transl. into ENGLISH from J. Zosen Kyokai (Japan), v. 105, 1959
(DTMB-Trans-298; AD-451236)

Collapse of circular cylindrical shells under external pressure was investigated in relation to the strength of submarine pressure hulls. Cylindrical shells collapse as a consequence of shell yielding when they are reinforced by closely spaced circular frames. This phenomenon takes place suddenly with a loud noise, and it seems, therefore, to be a sort of buckling accompanied by large plastic deformations. If shells are made literally in a circular form, the collapse pattern will be axially symmetric; hence, such collapse should be called axisymmetric collapse rather than shell yielding. Axisymmetric collapse was investigated by Von Sanden and Günther, and by Trilling. The behavior of shells is different from that predicted by these theories, and there follows even a marked discrepancy between experiments and the theory of Von Sanden and Günther. A rational theory is developed on the basis of the theories of plasticity and buckling; the validity of this theory was confirmed by experiments. When the cross-sectional area of the frames is comparatively small, collapse occurs over three frame spaces, and when large enough, between two consecutive frames. Author

N65-16105# General Technology Corp., Torrance, Calif.
STATE OF STRESS IN A CIRCULAR CYLINDRICAL SHELL WITH A CIRCULAR HOLE
A. C. Eringen, A. K. Naghdi, and C. C. Thiel Aug. 1964 80 p refs
(Contract NObs-78866)
(TR-3-6; AD-610524)

Analytical solutions are presented for the determination of the state of stress in a circular cylindrical, thin elastic shell having a circular hole on its lateral surface. The problems treated include the following cases of applied loads: (1) A uniform bending moment is applied to the edge of the hole; (2) The shell is subjected to a uniform axial tension; (3) The shell is subjected to internal pressure balanced by a uniformly distributed shear along the hole; and (4) The shell is subjected to a torque at its ends. By superposition of these results, the solution may be obtained of various other technically important cases, e.g., pressurized cylinder intersected by a circular cylindrical membrane with closed ends. For each of these cases, stresses and stress concentration factors are plotted against a natural parameter that involves dimensional ratios and Poisson's ratio. Formulas are presented for the calculation of membrane stress concentrations in the case of small hole. Author

N65-16109# Columbia U., New York, N.Y. Inst. for the Study of Fatigue and Reliability
THE ANALYSIS OF STRUCTURAL SAFETY
A. M. Freudenthal, J. M. Garrelts, and M. Shinozuka Oct. 1964 67 p refs
(Contract Nonr-266(91))
(TR-12; AD-608607)

The objectives were to formulate a clear definition of the term "Factor of Safety", to survey the field for currently employed factors, and to make suitable recommendations. It was concluded that, because of the nature of the data concerning the strength of a material or the loads to be designed for, only certain phases of the analysis can be dealt with by using probability techniques. Most of the studies were based on an assumed probability distribution for the material. The areas covered are: safety and probability of failure, multiple member structures, safety factors, and reliability functions. Tests were performed and reported on the safety analysis of aircraft wings, and the safety of a trussed tower against wind load. Evaluations were made for a general representation of arbitrary distribution functions, and the use of nonparametric methods. R.E.S.

N65-16153# Joint Publications Research Service, Washington, D.C.
VIBRATION IN COUPLED MARINE MECHANISMS RESULTING FROM IMPERFECT COAXIAL ALIGNMENT
V. S. Kravchenko 12 Feb. 1965 17 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), v. 29, no. 8, Aug. 1963 p 54–60
(JPRS-28740; TT-65-30321) OTS: $1.00

The role of imperfect shaft alignment in vibration of machinery is a matter of considerable interest. It is a well-known fact that changes in alignment occur during the process of transport, loading and assembly. This study was directed toward coupled mechanisms that make use of flexible couplings of typical design—sleeve-pin type couplings with rubber pins and rubberized pads or plate. Author

N65-16179# Federal Aviation Agency, Washington, D.C. Systems Research and Development Service
TESTS OF MATERIALS AND PACKAGING METHODS FOR USE IN AIRCRAFT WINDSHIELD BIRD-IMPACT SIMULATION
John Sommers, Jr. Aug. 1964 37 p refs
(FAA-ADS-23)

This program explored the possibilities of using a substitute material in place of a bird carcass for the impact-testing of aircraft windshields. Tests showed that the energy transfer characteristics on impact for clay, ground beef and chunk beef were quite close to those of a bird carcass in the velocity range between 115 and 300 knots. Between 300 and 400 knots impact velocity the characteristics of ground beef and chunk beef compared closely to the bird carcass, with chunk beef being more representative. Modeling clay was found to transfer more energy on impact than does a bird carcass between 300 and 440 knots, and putty transferred less energy throughout the test velocity range. A method of packaging the substitute materials was developed utilizing a 9-in long by 6-in diam styrofoam carrier. Author

N65-16213# Atomics International, Canoga Park, Calif.
EXPERIMENTAL STUDY OF INELASTIC STRAINS IN HOLLOW CYLINDER OF 6061 ALUMINUM SUBJECTED TO A BAND OF INTERNAL PRESSURE
Vincent W. Anderson 1 Feb. 1965 41 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9889) OTS: $2.00

Equipment was developed to subject a hollow cylindrical specimen to a limited band of internal pressure in order to put the cylinder material in a plastic state of strain. Strains on the outside surface of the cylinder were measured by electric strain gages mounted circumferentially and longitudinally on the cylinder, and were observed visually by the molding of a birefringent plastic bonded to the test cylinder. Internal cylinder pressures up to 640 psi were produced, developing strains up to approximately 2% circumferential expansion of the cylinder. The magnitudes and distribution of inelastic strains on the exterior surface of the test cylinder were determined. An analysis of strains within the region of the band of internal pressure revealed that peak strains on the exterior surface of the cylinder occurred at the midwidth region of the band pressure; at a distance of approximately one-third the bandwidth on either side, the longitudinal strains were compressive rather than tensile. Author

N65-16224# California Inst. of Tech., Pasadena, Calif. Graduate Aeronautical Labs.
LARGE ELASTIC DEFORMATION OF THIN CYLINDRICAL TUBES

Jen-shih Lee Oct. 1964 50 p refs Sponsored by AFOSR
(SM-64-38; AFOSR-64-2020; AD-608546)

An elastic, incompressible, isotropic material is considered, whose constitutive law is specified by a strain-energy function W which is a function of two strain invariants I_1 and I_2. Three types of deformation of thin circular cylindrical rubber tubes are discussed. In the first type a rubber tube is deformed into another circular cylindrical tube of different length and diameter by simultaneous inflation and extension of the tube. The second type of deformation considered is a stretching of the tube without internal pressure. In the third type, a tube is inflated by internal pressure, with or without a change in total length or end diameter. In the latter two types the deformed tube is a curved surface of revolution, and the calculations are restricted to a Mooney–Rivlin form of the equation for W. D.E.W.

N65-16286# Northrop Corp., Hawthorne, Calif. Norair Div.
EMPIRICAL CORRELATION OF EXCITATION ENVIRONMENT AND STRUCTURAL PARAMETERS WITH FLIGHT VEHICLE VIBRATION RESPONSE Technical Report, May 1962–Jul. 1964
R. W. White, D. J. Bozich, and K. M. Eldred Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Dec. 1964 138 p refs
(Contract AF 33(657)-8218)
(NOR-64-226; AFFDL-TR-64-160; AD-355248)

The design of fatigue-resistant structures for high-speed aircraft and aerospace vehicles depends largely on the prediction of realistic acoustic, fluctuating aerodynamic, and engine vibration environments, and on the estimation of the attendant vibration levels of structural components and attached equipment. The practical engineering limitations of the mathematical and numerical analyses required to treat such structures rigorously by classical dynamics necessitate studies of alternate, approximate methods. In this report, a definitive statement is presented of the empirical approach for determining correlations between the excitation environment and the vibration response of typical flight vehicle structures by means of statistical analyses of measured vibration data. The various aspects of the vibration prediction problem and the general philosophy motivating research in the area of empirical correlation are discussed. An engineering model for empirical correlation is developed, and several examples are given to demonstrate the utility of the equations. Author

N65-16302*# National Aeronautics and Space Administration, Washington, D.C.
STRENGTH OF ROTATING DISCS
Yasuo Sato and Fumio Nagai Feb. 1965 23 p refs Transl. into ENGLISH of Natl. Aeron. Lab. (Tokyo) Tech. Rept. NAL-TR-4, v. 9, Sep. 1960 p 1–16
(NASA-TT-F-9237; NAL-TR-4, Vol. 9) OTS: HC $1.00/MF $0.50

The deformation and the strength of rotating discs are discussed, and the results of the experiments on the burst of rotating discs are presented. The plastic deformation of the rotating disc varies with the stress distribution, which depends on γ_0, the ratio of inner to outer diameter of the disc. The strength, when the rotating disc of ductile material bursts in the diametral section, is considered as a function of γ_0, and the function is to be expressed approximately by the following formulas:

$$\bar{\sigma} = \sigma_{\beta}' \quad \text{for } \gamma_0 \neq 1,$$
$$\bar{\sigma} \neq 8/7\,\sigma_{\beta}' \quad \text{for } \gamma_0 \neq 0, \text{ and}$$
$$\bar{\sigma} = \sigma_{\beta}' \sim 8/7\,\sigma_{\beta}' \quad \text{for } 0 < \gamma_0 < 1,$$

where, $\bar{\sigma}$ is the mean value of the circumferential stress on the diametral section. The $\bar{\sigma}_{\beta}'$ is the strength of rotating ring. Author

N65-16336# Martin Co., Baltimore, Md. Engineering Dept.
STABILITY OF STIFFENED CYLINDERS
John M. Hedgepeth and David B. Hall Dec. 1964 46 p refs Presented at the Aerospace Sci. Meeting of the AIAA, New York, 25–27 Jan. 1965
(ER-13731)

Design of efficient cylindrical shells for carrying moderate compressive loads leads to the requirement that they be stiffened. How the buckling behavior of such stiffened cylinders differs from that of thin monocoque cylinders is discussed. Several methods, having varying complexity and versatility, are described for treating buckling of stiffened cylinders. The determination of the required ring stiffness for preventing general instability is identified as being central to optimum design; commonly used methods of determination are shown to be unreliable. Theoretical and experimental results are compared; future development is outlined. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-15450# Aeronautical Research Labs., Wright-Patterson AFB, Ohio. Thermomechanics Research Lab.
NATURAL CONVECTION IN BOTTOM NEIGHBORHOOD OF VERTICAL CYLINDERS
M. G. Scherberg Feb. 1963 18 p refs
(ARL-63-57; AD-401843)

Solutions are presented for the natural convection in the bottom neighborhood of large and small radius vertical cylinders under proper nonisothermal boundary conditions in this region. It is shown that the boundary layer appears to diverge in thickness as the bottom is approached. Some interesting differences between large and small cylinders are noted. Author

N65-15509# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSACTIONS OF POWER ENGINEERING
10 Sep. 1964 244 p refs Transl. into ENGLISH from Tr. Inst. Energ., Akad. Nauk Belorussk. SSR (Minsk), v. 3, 1957 p 1–209
(FTD-TT-62-1516/1+2; AD-608107)

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15. USE OF THERMISTORS FOR MEASUREMENT OF TEMPERATURE V. N. Stanishevskiy p 224–229a refs (See N65-15513 06-14)

16. CHOICE OF VOLTAGE FOR A LOW-VOLTAGE METROPOLITAN LINE R. I. Klionskaya p 230–234 refs

N65-15510 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF DETERMINING HEAT TRANSFER IN MOLTEN METALS AS A RESULT OF NATURAL CONVECTION

A. I. Veynik *In its* Trans. of Power Eng. 10 Sep. 1964 p 70–76b refs (See N65-15509 06-33)

A method is suggested for finding the intensity of heat transfer in a molten metal by immersing a solid of appropriate shape in a melt. The solid requires a certain thermal resistance on the surface. When the solid begins to interact, it produces considerable heat flow, leading to the formation of a solidified skin of a certain depth. After peak heating, the heat flow is reduced and the skin remelted because the quantity of heat entering through the skin becomes less than the quantity of heat transmitted to the skin from the molten metal. The excess is dissipated in melting the skin. Formulas are derived to relate the depth for the solidified skin to the magnitude of the heat-transfer coefficient. The development of these equations is described. R.E.S.

N65-15531*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL STUDY OF SUBCOOLED NUCLEATE BOILING OF WATER FLOWING IN 1/4-INCH-DIAMETER TUBES AT LOW PRESSURES

Frank A. Jeglic, James R. Stone, and Vernon H. Gray Washington, NASA, Jan. 1965 36 p refs

(NASA-TN-D-2626) OTS: HC $2.00/MF $0.50

The nucleate boiling of subcooled water flowing vertically upward through 1/4-inch electrically heated tubes was experimentally investigated over the following range of conditions: exit pressure, 17 to 100 pounds per square inch absolute; flow rate, 0.52×10^6 pounds per hour per square foot; heat flux, up to 3.0×10^6 Btu per hour per square foot; wall temperature, up to 520° F; liquid subcooling, up to 180° F; and tube length, 25, 50, and 100 diameters. Measurements of local heat flux, axial distribution of tube wall temperature, tube inlet and exit fluid temperatures and pressures, and inlet pressure fluctuations were obtained. Plots of heat flux, pressure drop, and pressure fluctuations are presented as functions of exit fluid temperature, wall temperature, and saturation temperature. Author

N65-15536*# Multi-Tech, Inc., San Fernando, Calif.

LIQUID ROCKET COMBUSTION PROCESSES Progress Report No. 2

Frank B. Cramer [1964] 15 p Prepared for JPL *Its* Rept.-4244-3

(Contracts NAS7-100; JPL-950926)

(NASA-CR-59498) OTS: HC $1.00/MF $0.50

An evaluation of more than 5000 various abstracts on liquid-propellant rocket engine combustion processes was made to find the existing major information gaps. The results are presented in brief summaries for: *Injection and Stream Location, Stream and Drop Breakup, Multiple-Phase Transport and Dispersion, Combustion Processes,* and *Combustion Support Waves.* G.G.

N65-15539# Tokyo U. (Japan).

HEAT TRANSFER BY FREE CONVECTION FROM UNIFORMLY HEATED HORIZONTAL CYLINDER

Taik Sik Lee [1964] 6 p refs *In* JAPANESE; ENGLISH summary

A Zehnder–Mach interferometer was used to study the free convection heat transfer about a uniformly heated horizontal cylinder. The experiments were performed when the cylinder was immersed in air and the steady-state case, and transient development from an initial state at rest and with constant heat flux to steady-state condition was investigated when a step impulse in the power input to the cylinder was applied. Results for the steady-state temperature profile agreed fairly with the results of an analysis by Hermann. The transient runs indicated that the surface temperature initially increased exponentially and then reached the steady-state value asymtotically after a short transition period. The pure conduction mechanism of heat transfer near the wall of the heated cylinder terminated more rapidly when the heat flux was larger and the azimuth angle was smaller. Author

N65-15559# ARO, Inc., Arnold Air Force Station, Tenn.

SHOCK-INDUCED SUPERSONIC COMBUSTION IN A CONSTANT AREA DUCT

P. M. Rubins and T. H. M. Cunningham Arnold Eng. Develop. Center, Jan. 1965 39 p refs

(Contract AF 40(600)-1000)

(AEDC-TDR-64-266; AD-453974)

A two-oblique-shock compression was used as a reaction-initiating mechanism for the H_2-air reaction in a constant area duct while maintaining supersonic flow. Gradual pressure rise from chemical heat release was observed as fuel concentration was increased until the duct flow was choked. It was concluded that shock-induced combustion: (1) is experimentally feasible in ducted flow; (2) can be controlled by varying inlet temperature, pressure, Mach number, or fuel concentration; (3) may be analyzed as a one-dimensional flow for the

small models investigated if average stream properties are used; and (4) experimentally produces ignition delay times that agree with existing chemical kinetic flow computations within the accuracy that stream properties can be determined. The possible use of shock-induced combustion for air-breathing hypersonic propulsion is also discussed. Author

N65-15600# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
LABORATORY SIMULATION OF HYPERVELOCITY HEAT TRANSFER PROBLEM DURING PLANETARY ENTRY
J. S. Gruszczynski, W. R. Warren, Jr., and N. S. Diaconis Nov. 1964 54 p refs Presented at the 15th Intern. Astronautical Congr., Warsaw, 7–12 Sep. 1964
(R64SD73; AD-451664)

Outlined are laboratory techniques for the simulation of heat-transfer environments experienced by a space vehicle entering planetary atmosphere with superorbital velocity. Stagnation point convective heat-transfer and high-temperature gas radiance are studied in an electric discharge driven shock tube, in which flight velocity simulation up to 60 000 ft/sec was attained. The investigation of the response of materials used for vehicle heat shields requires flow durations much longer than those obtained in the shock tube. Therefore, an electric arc facility in which the required stagnation point gas properties are produced was employed in such a study. A new test technique that permits the evaluation of material performance in an environment with high radiative and convective energy fluxes is described. Some results of heat transfer and material response study in simulated atmospheres of Mars and Venus are also presented. Author

N65-15610*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPLICATION OF THE DOUBLE SPHERICAL HARMONICS METHOD TO THE ONE-DIMENSIONAL RADIATION-TRANSFER EQUATION
Leo G. Le Sage Washington, NASA, Feb. 1965 28 p refs
(NASA-TN-D-2589) OTS: HC $2.00/MF $0.50

The problem of the transport of thermal radiation through an absorbing medium between parallel walls held at fixed different temperatures is considered. The method of solution is based on a procedure introduced by Yvon in the analysis of monoenergetic neutron transport and employs double spherical harmonics expansions of the specific intensity. Formulas for the energy transport between the walls and the temperature distribution in the medium are obtained for a simple approximation. Numerical results are obtained for a more complicated approximation. The results are compared to previously published values. Author

N65-15616# Naval Ordance Lab., White Oak, Md. Explosions Research Dept.
PROPAGATION FAILURE IN SOLID EXPLOSIVES UNDER DYNAMIC PRE-COMPRESSION
B. E. Drimmer and T. P. Liddiard, Jr. 22 Jul. 1964 18 p refs
(NOLTR-64-60; AD-447156)

Steady-state detonations were stopped on entering a zone in a solid explosive already under compression by a 5 to 20 kb shock. Tests with PBX 9404 and EL-506C indicate that such quenching of detonation may be a general phenomenon of explosives. This implies that energy-concentrating systems (hot spots) are required even for steady-state detonations. Author

N65-15699# Aerojet-General Corp., Sacramento, Calif. Propellant Research Div.
INVESTIGATIONS OF THE MECHANISMS OF DECOMPOSITION, COMBUSTION, AND DETONATION OF SOLIDS Nineteenth Quarterly Technical Operating Report, 1 Jul.–30 Sep. 1964
L. J. Rosen Oct. 1964 16 p refs
(Contract AF 49(638)-851; ARPA Order 24-60)
(Rept.-0372-01-19Q; AD-450504)

Apparent flame strength (AFS) measurements were made on the ammonia–nitric oxide and ammonia–nitrous oxide flame reactions in the opposed-jet reactor at pressures ranging from 100 to 745 torr. The pressure dependencies of the apparent flame strengths of these systems gave overall reaction orders of 1.56 and 2.0 for NH_3–NO and NH_3–N_2O counterflow diffusion flames, respectively. The overall stoichiometry of the NH_3–NO flame near extinguishment can be represented by the following equation: $1.5\ NH_3 + NO \rightarrow 1.25\ N_2 + 1.25\ H_2 + H_2O$. The volumetric reaction rate for this flame reaction was computed using Spalding's analysis of the opposed-jet flame. At 1 atm, an apparent flame strength of 0.65 gm/cm^2-sec corresponded to volumetric reaction rate of 2.93 gm/cm^3-sec release rate of 7.22×10^3 cal/cm^3-sec. Author

N65-15766# General Electric Co., Pleasanton, Calif. Special Purpose Nuclear Systems Operation
RESEARCH AND DEVELOPMENT OF THERMIONIC CONVERSION OF HEAT TO ELECTRICITY Quarterly Report, Jun. 30–Sep. 29, 1964
John E. Van Hoomissen, A. I. Kaznoff, L. N. Grossman, and R. H. Bristow 29 Sep. 1964 6 p
(Contract NObs-90496)
(QR-1; AD-450863)

In the development program for a nuclear thermionic electrical generating system, work is being performed in three major areas, viz, UO_2-refractory metal reaction kinetics, insulator materials development, and ceramic-to-metal seal development. In the first area, studies are being conducted of the diffusion of uranium from urania, through tungsten and molybdenum; and the diffusivity of oxygen through molybdenum cladding used for fuel elements. A time-of-flight mass spectrometer is described that will be used for studies of insulator materials. Studies for the development of high temperature, cesium-resistant ceramic-to-metal seals included the determination of processing parameters for producing cesium-resistant metallizing layers, the preparation of graded cermet structures from molybdenum–alumina compositions, nickel braze-diffusion-bonding for metal-to-metal joining, and cesium corrosion testing. D.S.G.

N65-15769# Aeronutronic, Newport Beach, Calif.
INVESTIGATION OF THERMODYNAMIC PROPERTIES OF ROCKET COMBUSTION PRODUCTS Seventh Quarterly Technical Report, 1 Sep.–30 Nov. 1964
D. L. Hildenbrand, L. P. Theard, and F. Ju 1 Jan. 1965 8 p refs
(Contract AF 04(611)-8523; ARPA Order 348-62)
(U-2969; AFRPL-TR-65-17; AD-455376)

In the program to provide thermodynamic data for beryllium species in cases where critical uncertainties exist, the principal effort was centered on the determination of the heats of formation of gaseous species in the Be-O, Be-O-H, Be-F, and Be-Cl systems. The previously reported value, 76.9 kcal/mole, for the heat of sublimation of beryllium, was determined using a sample of 99% purity; and using a sample of 99.9% purity, a value of 77.3 ±0.1 kcal/mole was obtained. The mass spectrometer was used to study vapor

equilibria in Be-F and Be-Ca-F systems; and vapor species were produced by fluorinating elemental beryllium with CaF_2 and BF_3 in beryllia effusion cells. Appearance potentials for beryllium-containing ions are reported, and equilibrium constants and third-law heats obtained from the Be + CaF_2 system and from the Be + BF_3 system are presented. The vaporization of beryllium oxide is being studied by the torsion-effusion method, and current results are discussed. D.S.G.

N65-15782# Princeton U., N.J.
THERMODYNAMIC METHODS OF HIGH-TEMPERATURE MEASUREMENT
Jerry Grey Wright-Patterson AFB, Ohio, ARL, Oct. 1964 64 p refs
(Contract AF 33(657)-9962)
(ARL-64-179; AD-609977)

Three thermodynamic temperature measurement techniques—pneumatic devices, heat-transfer gages, and calorimetric methods—are presented. The appropriate devices and methods for each of the three techniques are described, and their different principles of operation, present status, range of applicability, and performance in thermodynamic temperature and enthalpy-measuring techniques are discussed. These thermodynamic probes represent the only suitable methods for measuring the extremely high gas enthalpies and temperatures when opaque gases or high-temperature gradients are present. G.G.

N65-15900# Little (Arthur D.) Inc., Cambridge, Mass.
RESEARCH ON THERMODYNAMICS OF THE Al-B-O, Be-B-O, AND Al-Be-O SYSTEMS Quarterly Report, 1 Sep.–30 Nov. 1964
Paul E. Blackburn [1964] 21 p refs
(ARPA Order 315-62)
(QR-10; AD-454996)

Data were obtained on the evaporation coefficient of liquid B_2O_3, on mass spectra for the Be-B-O system, on the pressure over the two-phase system $9Al_2O_3 \cdot 2B_2O_3$–Al_2O_3, on the vapor pressure of rhenium, and on the effusion of Al_2O_3. A least-squares fit of both Langmuir and Knudsen measurements of boric oxide vapor pressure gives a ΔH_T of 92.6 ±1.6 kcal/mole. Both the gravimetric and mass spectrometric experiments indicate a low evaporation coefficient for the mixed Be-B-O system. For the two-phase Al-B-O system, the orifice area effects are quite large, indicating a very small evaporation coefficient. Tables summarize the vapor pressure and the heat of vaporization of rhenium, the cell material chosen to study the Al-B-O system. The measured Al_2O_3 effusion rates compare to the rates computed from the JANAF tables, indicating that the bulk of the oxide vaporizes to atoms of aluminum and oxygen. R.L.K.

N65-15942*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL AND EXPERIMENTAL STUDY OF POOL HEATING OF LIQUID HYDROGEN OVER A RANGE OF ACCELERATIONS
Robert W. Graham, Robert C. Hendricks, and Robert C. Ehlers Washington, NASA, Feb. 1965 54 p refs
(NASA-TN-D-1883) OTS: HC $3.00/MF $0.50

Pool heating of liquid hydrogen in the subcritical and supercritical pressure states was investigated at earth gravity and multigravities. Acceleration does influence the incipience of nucleate boiling, but does not affect established nucleate boiling. The film-boiling heat transfer is influenced by multi-g accelerations. A mechanism similar to boiling was evident for hydrogen in the supercritical and near-critical state. Acceleration magnitude influenced the heat transfer in this fluid regime. High-speed motion pictures of the heat-transfer processes were taken in both the subcritical and supercritical pressure states at earth gravity and multigravities. Author

N65-15948*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUCLEATE AND FILM BOILING IN REDUCED GRAVITY FROM HORIZONTAL AND VERTICAL WIRES
Robert Siegal and Edward G. Keshock Washington, NASA, Feb. 1965 35 p refs
(NASA-TR-R-216) OTS: HC $2.00/MF $0.50

Nucleate boiling was studied experimentally from electrically heated horizontal and vertical wires (0.0197-in. diam) in water, ethyl alcohol, and 60-percent-by-weight aqueous sucrose solution in gravity fields of 0.014 and 1.0 times earth gravity. The fluids were at their saturation temperatures at atmospheric pressure. The gravity reduction to 0.014 times earth gravity caused a shift of only a few degrees in the curve of heat flux, as a function of the difference between surface and saturation temperatures. Film boiling of ethyl alcohol was observed at earth gravity and at several reduced gravity fields down to 0.014 times earth gravity. For both the horizontal and the vertical orientations, the gravity field and the circumferential surface tension at the interface of the vapor film surrounding the thin wire proved to be very important for the determination of the vapor removal pattern. As gravity was reduced, the vapor film behavior for the vertical orientation approached that for the horizontal position. Author

N65-15967# Toronto U. (Canada).
AN EXPERIMENTAL INVESTIGATION OF SPHERICAL COMBUSTION FOR THE UTIAS IMPLOSION DRIVEN LAUNCHER Interim Technical Report
André Benoit Wright-Patterson AFB, Ohio, ARL, Oct. 1964 153 p refs
(Contract AF 33(657)-7874)
(ARL-64-130; AD-609899)

An experimental investigation of the combustion processes occurring in the UTIA implosion driven hypervelocity launcher combustion chamber was conducted in stoichiometric mixtures of hydrogen–oxygen, diluted with an excess of hydrogen or helium. The mixtures were ignited using a spark gap or an exploding wire at the geometric center of the hemispherical vessel, and piezopressure gage histories were recorded for various dilutions and initial pressures ranging from 75 to 1000 psi. Heat-transfer and ionization gages were used to measure average combustion wave speeds and to investigate the wave symmetry. Calculations of the final conditions after complete combustion (constant volume combustion assuming no dissipative effects) were made, taking dissociations into account. The derived pressures were compared with those obtained experimentally. Author

N65-16049# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
THERMAL DIFFUSIVITY MEASUREMENT TECHNIQUE FOR VERY HIGH TEMPERATURES
J. Kaspar and E. H. Zehms 30 Dec. 1964 30 p refs
(Contract AF 04(695)-469)
(SSD-TDR-64-276; TDR-469(5250-10)-7; AD-455136)

A new technique for measuring the thermal diffusivity of solids at very high temperatures was demonstrated. This method effectively eliminates the influence of radiant boundaries, and therefore their characteristic Nusselt numbers, on the observables used to determine the thermal diffusivity. It was shown that this can be achieved by exposing the outside faces of a pair of discs to identical periodic flux variations, and determining the properties of the complex temperature amplitude ratios of one of the discs. This approach is contrasted with the conventional single-disc method where the same ratio is strongly affected by the Nusselt number of the back side of the disc, which is not exposed to periodic flux variations. The CEP-type graphite was used to demonstrate the performance of this method in the temperature region between 2000° and 3000° K. Author

N65-16079*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center

A COMPARISON OF SEVERAL AERODYNAMIC HEAT TRANSFER PREDICTION METHODS Final Report

A. S. Perlman and S. F. Lodefink Dec. 1964 73 p refs

(Contract NAS8-11148)

(NASA-CR-60482; H-64-005; LMSC/HREC-A036388) OTS: HC $3.00/MF $0.75

A study was conducted to review and evaluate the analytical methods used to predict aerodynamic heat transfer to boost vehicles and to select the more appropriate methods for use in a general heat-transfer computer program. To ascertain the methods which best predict the aerodynamic heating, the results obtained by the analytical methods were compared with flight and/or wind tunnel test results. Methods that are evaluated are classified into three categories: (1) stagnation point heating methods; (2) laminar heating methods; and (3) turbulent heating methods. Each group was examined separately. Data comparisons are presented for the stagnation point methods and the turbulent methods. Data comparisons for the laminar heating methods were not performed for this study because adequate comparisons are available in the literature. Additional experimental data covering higher values of enthalpy and various velocity gradients are required to further discriminate between several of these methods. Author

N65-16081*# Marquardt Corp., Van Nuys, Calif.

FEASIBILITY STUDY OF OXYGEN/HYDROGEN POWDERED METAL IGNITION First Quarterly Progress Report, 16 Sep.–15 Dec. 1964

J. L. Jones 21 Dec. 1964 30 p refs *Its* Rept.-25151

(Contract NAS8-11250)

(NASA-CR-60478) OTS: HC $2.00/MF $0.50

Analytical studies included a review of the use of metallic catalysts and pyrophoric metals to produce ignition of mixtures of hydrogen and oxygen; experimentally, it was found that the noble metal catalysts, such as platinum, reacted well for hypergolic ignition. Another method of ignition considered was based on catalysis of the ortho–para conversion of hydrogen at low temperature. Zinc oxide was found to provide strong adsorption of the hydrogen and very rapid parahydrogen conversion. In the phase of planning experimental programs, a liquid oxygen–hydrogen propellant system was designed for more quantitative tests. Preliminary H_2–O_2 ignition studies were begun, using a platinum catalyst in three different experimental setups that provided varying degrees of parameter control. There was no noticable qualitative deterioration of characteristics in 6 days of use. Further testing with Raney nickel powders and other pyrophoric metal powders showed them to be very pryophoric at room temperature and much more so in a vacuum pretreatment. Successful results were found by forming colloidal suspensions of the metal in suitable liquid carriers. Evaluations are being made of all experimental data. R.E.S.

N65-16090# Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.

INITIATION OF EXPLOSIVES BY EXPLODING WIRES. IV: EFFECT OF WIRE LENGTH ON THE INITIATION OF PETN BY EXPLODING WIRES

Howard S. Leopold Jul. 1964 25 p refs

(NOLTR-64-61; AD-601990)

The effect of wire length on the initiation of PETN by exploding platinum wires was investigated using a one-microfarad capacitor charged to 2000 V as the energy source. The energy density deposited in the wire was found to increase with decreasing wire length, but there is an optimum length for effecting detonation. This is apparently governed by the energy density deposited in the wire and a minimum critical volume of explosive that must be initiated. Author

N65-16111# Stanford U., Calif.

SPOT COOLING AND HEATING OF SURFACES WITH HIGH VELOCITY IMPINGING AIRJETS. PART 2: CIRCULAR JETS ON PLANE AND CURVED SURFACES, SLOT JETS ON CURVED SURFACES

Dieter Richard Walz Jul. 1964 148 p refs

(Contract Nonr-225(23))

(TR-61; AD-607727)

Average heat-transfer coefficients were determined experimentally for small, high velocity air jets impinging normally on flat and curved surfaces. Jets of both circular and flat rectangular (slot) cross sections were used. The transient temperature response of the copper target, forming the surfaces in question, was used to deduce the convective heat-transfer coefficient. The reduced data are given in nondimensional form to maintain generality and to allow application to other geometrically similar configurations and for fluids other than air. Author

N65-16154*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EVALUATION OF MATERIALS IN ENTRY HEATING SIMULATION

William A. Brooks, Jr. [1964] 54 p refs Presented at the Conf. on the Role of Simulation in Space Technol., Blacksburg, Va., 17–21 Aug. 1964

(NASA-TM-X-54976) OTS: HC $3.00/MF $0.50

The partial simulation of a few of the reentry heating parameters on a scaled-down reentry specimen with full-scale heat shield materials is discussed. Emphasis is placed on the test responses of the charring ablators to radiative and convective heating, and their mechanical erosion by aerodynamic shear. Char strength tests of a molded phenolic–nylon and a glass reinforced epoxy resin showed that the phenolic material experienced no difficulty at a low shear level, whereas the epoxy material eroded significantly. It was concluded that all entry heating parameters such as enthalpy, pressure, heating rate, aerodynamic shear, etc., affect material performance, and that the significance of the environmental effects on the behavior of ablation materials depends largely on the type of material used. G.G.

N65-16158# IIT Research Inst., Chicago, Ill.
LIQUID PROPELLANT VAPORIZATION AND DISINTEGRATION
Ronald Joseph Steinke (M.S. Thesis) Jun. 1964 37 p refs

The results of the calculations revealed that the temperature change of the liquid jet, determined by the mass and heat transfer equations, is of the same order of magnitude as the temperature variation of the drop. The analysis predicted the experimental drop diameter measurements for the Freon-12 and air system within experimental data scatter. The calculated liquid Freon-12 velocities were approximately 8% higher than the experimental values. This discrepancy can be eliminated by using a smaller coefficient of drag in the analysis. The percentage of total heat transfer due to radiation for the drops was calculated to be less than 1% for an airstream and wall temperature of 544° R. However, this percentage increased to 4.7% for an airstream and wall temperature of 1,200° R. At higher temperatures, this percentage is expected to increase further. Also, the percentage of heat radiation was calculated to be at least five times higher for liquid jets than for drops. Author

N65-16165# Naval Ordnance Lab., White Oak, Md.
THE CRITICAL CONDITIONS IN THERMAL EXPLOSION THEORY FOR *nth* ORDER REACTIONS
J. Adler (Imp. Coll. of Sci. and Technol., London) and Julius W. Enig 28 Sep. 1964 8 p ref
(NOLTR-64-180; AD-450970)

The work is an extension of work dealing with first order chemical reactions. Cases where the material decomposes exothermically according to an *nth* order single-step reaction are considered, and the relations between various parameters at the point of criticality are obtained. It is shown how this condition arises by a mathematical analysis of the problem. R.E.S.

N65-16178# Aircraft Porous Media, Inc., Glen Cove, N.Y. Porous Metals Dept.
TRANSPIRATION COOLING THROUGH RIGIMESH SINTERED WOVEN WIRE SHEET
Martin G. Kurz 1 Jun. 1964 21 p
(APM-FSR-18B)

The properties, machining, and applications of Rigimesh sintered woven wire mesh sheets are discussed. Laboratory tests proved their effectiveness as transpiration material. Afterburner liners, combustion chamber liners, and turbine blades for turbojet engines were constructed from this material, and a Rigimesh plate, which uses cryogenic hydrogen for transpiration cooling, was utilized in the fuel injection part of liquid hydrogen–oxygen engines. A number of other applications are being evaluated. G.G.

N65-16193# Syracuse U., N.Y.
HEAT TRANSFER IN LAMINAR AND TURBULENT FLOWS BETWEEN PARALLEL PLATES WITH TRANSVERSE FLOW
Shaw Mei Lee and William N. Gill [1962] 28 p refs
(Contract Nonr-669(17))

The effect of constant crossflow on laminar and turbulent channel flows was investigated, and temperature profiles, velocity distributions and wall gradients were determined. Transverse flow has a profound influence on heat transfer characteristics, and its importance increases with N_{P_r}. It was found that the results for turbulent forced convection in conduits can be correlated in a remarkably simple manner. That is, the ratio of heat transfer coefficients with and without crossflow, to a good approximation, is a unique function of the reduced transverse velocity divided by the Stanton Number. These results should provide a reasonable basis for design estimates. Author

N65-16210# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Electromechanical Div.
RADIATOR DESIGN LIMITATIONS FOR DYNAMIC CONVERTERS
Alfred Koestel and Cameron M. Smith Paris, AGARD [1964] 91 p refs Presented at the 6th AGARD Combust. and Propulsion Colloq., Energy Sources and Energy Conversion, Cannes, France, 16–20 Mar. 1964

The general design of a direct radiator-condenser is described, and the two-phase fluid mechanics of the condensing process and its application in the design of a radiator for a space powerplant are presented. Minimum total powerplant weight is the design goal. The design criteria for a radiator-condenser were established from the assumptions: that the condensing temperature is equal to that for the outer surface of the tube; that the temperature gradients along the tube can be neglected; that the radiant heat exchange between the fin and tube is insignificant; that the turbine efficiency is constant; and that the weight of the powerplant components other than that for radiator-condenser is a function of the cycle efficiency determined by the condensing temperature. G.G.

N65-16220# California U., Livermore. Lawrence Radiation Lab.
A PROCEDURE FOR THE NUMERICAL TREATMENT OF GENERALIZED HEAT-TRANSFER PROBLEMS
Michael D. Mintz Nov. 1964 38 p
(Contract W-7405-ENG-48)
(UCRL-7960)

A general procedure is presented for the numerical analysis of practical heat transfer problems of virtually any degree of complexity. The processes of conduction, convection, grey and translucent body radiation, internal heat generation, and transient heat energy storage and mass transfer are considered. Material properties are assumed to be arbitrary functions of temperature. It is intended that the actual numerical calculations will be performed by a digital computer with suitable subroutines for matrix inversion. The simplicity of expressing these methods in the form of a FORTRAN digital computer code is demonstrated by a straightforward sample problem, the analyses of a rotating spherical shell in the field of a plane wave radiation energy flux. The methods described are the basis for numerous digital computer codes employed in the design and analysis of the Tory II-C nuclear ramjet engine (Project PLUTO). Use of these codes resulted in a considerable saving in component design time and the elimination of needless, overly conservative safety margins. Author

N65-16258*# National Beryllia Corp., Haskell, N.J.
RESEARCH ON LOW DENSITY THERMAL INSULATION MATERIALS FOR USE ABOVE 3000°F Third Quarterly Status Report, 1 Jul.–30 Sep. 1964
K. H. Styhr [1964] 18 p refs
(Contract NASw-884)
(NASA-CR-60542)

Research on heat-transfer phenomena in low-density ceramic foam insulation is described, with emphasis on the properties of composite foams containing dispersed metallic

additives. Physical properties of high purity zirconia raw materials are discussed as they affect foam properties. Problems related to thermal stress effects in ceramic foams are described, along with equipment calibration using ASTM standard specimens. Measured thermal conductivity data for tungsten-modified zirconia foams are presented in comparison with unloaded foam. Author

N65-16270# Stanford Research Inst., Menlo Park, Calif.
THE ROLE OF ALUMINUM AND ITS OXIDES AS SOURCES OR MODERATORS OF ELECTRONS IN SOLID PROPELLANT ROCKET EXHAUSTS Annual Report, 1 Jul. 1962–30 Jun. 1963
G. Neil Spokes [1963] 36 p refs
(Contract AF 04(694)-128)
(AD-426973)

Five theoretical approaches to an understanding of gas-particle plasmas are outlined. Laboratory experiments were made on the microwave properties of gas-particle plasmas. Observed ionization can be accounted for in terms of alkali metal impurity ionization. Photoelectric and electron paramagnetic resonance studies of α and γ-alumina particles have indicated that spin centers in the particles may be the cause of previously observed photoelectric effect radiation with 1849 A. Studies indicate that aluminum oxide with lattice defects may have a work function of 3.7 eV. The literature values for the Al_2O_3 band gap as determined by electrical conduction are not well understood. Pure single crystal alumina probably has a large band gap in consequence of which the defect-free alumina work function may be higher than 4.38 eV. Excess aluminum and lattice defects in particles of alumina in rocket exhausts may give a particle work function of 3.72 eV. Author

N65-16295# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FUNDAMENTAL PRINCIPLES OF TEMPERATURE MEASUREMENT WITH LOOSE HEAT COUPLING
Andras Haas 22 Dec. 1964 11 p refs Transl. into ENGLISH from Meres es Automatika (Hungary), v. 11, no. 12, 1963 p 369–371
(FTD-TT-64-865/1+3+4; AD-455514)

Temperature measurement with loose-heat coupling is a methodologically new thermometry technique. It casts new light on the problems of single-valuedness and calibration in surface and contract temperature measurements. The older close-coupled thermometry technique can be regarded as a limiting case of the measurement procedure developed according to these new concepts. Loose-heat-coupled thermometry does not pretend to replace the older methods with close-heat coupling, but, to the contrary, proposes to supplement them in regions in which there would be no point in using the latter. Author

N65-16308*# National Aeronautics and Space Administration, Washington, D.C.
CERTAIN PROBLEMS IN THE THERMODYNAMICS OF THE CRITICAL POINT [NEKOTORYYE VOPROSY TERMODINAMIKI KRITICHESKOY TOCHKI]
V. V. Sychev Feb. 1965 18 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur (USSR), v. 2, no. 4, 1964 p 573–582
(NASA-TT-F-9251) OTS: HC $1.00/MF $0.50

Problems are considered in the thermodynamic theory of the critical point of a pure substance and it is shown that the quantity $(\partial^2 p/\partial T \partial v)$ vanishes identically at the critical point. It is concluded that the method of expanding certain thermodynamic functions in Taylor series in powers of the deviation from the critical point is of limited applicability. Author

N65-16316*# Lockheed Missiles and Space Co., Huntsville, Ala. Huntsville Research and Engineering Center
A COMPUTER PROGRAM FOR TRANSIENT THERMAL ANALYSIS OF ARBITRARY SHELLS OF REVOLUTION
W. D. Whetstone May 1964 45 p ref
(Contract NAS8-11148)
(NASA-CR-60554; LMSC/H/64-001) OTS: HC $2.00/MF $0.50

The program is based on the well-known numerical solution method in which bodies are idealized as assemblages of small nodes, or volume elements. Computational techniques employed are discussed in detail, and all essential FORTRAN variables are defined. Characterizing features of the program are: (1) A very large number of nodes is permissible, allowing representation of bodies as very fine nodal networks. The present nominal limit of 5000 nodes can be expanded significantly without difficulty (most other transient heat conduction programs are limited to a few hundred nodes). Input data are composed of concise problem definitions: viz, the geometry of the shell, material properties, boundary conditions, and a small number of numerical solution parameters. External boundary conditions are specified in the input data in the form of convective heat rates (i.e., net heat rates excluding exchange), which are piecewise linear functions of time and location over the exterior surface. Author

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Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-15460 Army Medical Research and Nutrition Lab. Denver, Colo.
THE IMPACT OF ADMINISTRATIVE LIMITATIONS ON THE DESIGN OF EXPERIMENTS
Gerhard J. Isaac *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 229–233 (See N65-15451 06-19)

Experiments often must be carried out with less than ideal designs because of limitations having their origin at administrative levels. Designs may be modified to reflect administrative decisions on the utilization of available resources of personnel, funds, and equipment in a research program. The nature and effect of some of these modifications are discussed. An example is presented, and some alternatives are explored. Author

N65-15461 Army Chemical Center, Edgewood, Md.
VERIFICATION OF PRODUCT ACCEPTANCE INSPECTION BY ATTRIBUTES
Joseph Mandelson *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 235–240 Presented at Conf. on Reliability Assurance Tech. for Semi-Conductor Specification (See N65-15451 06-19)

The procedures collectively called product verification are based on the philosophy that, if the supplier's quality inspection system is competently established and run so that it yields valid objective data, his data may serve as a basis for acceptance by the consumer. These procedures involve: the determination that the supplier has the organization and physical means to perform all the inspections and tests required by the contract to establish the acceptability of the product; the determination that the supplier has a definite test plan or program, and a reporting system that will provide the technical findings; the use of explicit inspection and test procedures and standards; and the validation of the supplier's data by the consumer's inspection and tests. Each of these procedures is described in detail, and their importance in quality assurance programs is emphasized. Attention is called to the fact that the supplier must recognize that his quality inspection system is being sold as a service to the consumer. D.S.G.

N65-15473 Virginia Polytechnic Inst., Blacksburg.
WHAT TYPE OF STATISTICIANS ARE NEEDED IN RESEARCH AND DEVELOPMENT LABORATORIES
Boyd Harshbarger et al *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 547–568 refs (See N65-15451 06-19)

The development of mathematical statistics and the statistical design of experiments are outlined. Statistical personnel associated with agricultural research are described, and the needs of the statistical engineering programs of the National Bureau of Standards are discussed at length. Educational backgrounds desired in statisticians, and desirable attributes of statisticians in R&D laboratories are summarized. The role of statistics in the Air Force R&D program is considered; the describable characteristics of a statistician, including areas of expertise, are discussed; and the types of statisticians needed are described. This paper is a collection of short presentations at a panel discussion. D.E.W.

N65-15477 War Office, London (England). Artillery Research and Development
THE MEASUREMENT OF THE MORALE AND SUPPRESSIVE EFFECTS OF WEAPONS
D. H. Chaddock *In* Army Res. Office Proc. of the 9th Conf. on the Design of Expt. in Army Res., Develop. and Testing Dec. 1964 p 649–653 (See N65-15451 06-19)

Effects of weapons other than physical damage are discussed. Such effects as raising the morale of the firing group and deterring the attacker are considered with regard to their influence on choice of weapons. The possible existence of a "threshold" value of assessed danger in a situation, above which the contemplated action is too risky to pursue, is also discussed. D.E.W.

N65-15565# Naval Ordnance Lab., Corona, Calif.
FOUNDATIONAL RESEARCH PROJECTS Quarterly Report, Jan.–Mar. 1963
C. J. Humphreys 1 Jun. 1963 87 p refs
(NAVWEPS-8150; AD-409856)

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N65-15681# Joint Publications Research Service, Washington, D.C.
DIALECTICAL MATERIALISM AND PRESENT-DAY NATURAL SCIENCE
M. I. Vigdorovich, ed. 2 Feb. 1965 383 p refs Transl. into ENGLISH of "Dialekticheskiy Materializm i Sovremennoye Vestestvoznaniye" Moscow, Publ. House of Moscow U., 1964 p 1–406 Collection of articles presented at all-Russ. Seminar of Social Sci. Instructors on Phil. Probl. of Present-day Natural Sci., 1961
(JPRS-28577; TT-65-30253) OTS: $7.00

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20. DEFECTS OF THE VULGAR SUBJECTIVIST INTERPRETATION OF THE NATURE OF THE PSYCHIC F. I. Georgiyev p 364–372 refs

N65-15784# Mitre Corp., Bedford, Mass.
SYSTEM INSTALLATION AND TESTING
F. W. Hopkins AFSC, Electron. Systems Div., Dec. 1964 24 p
(Contract AF 19(628)-2390)
(ESD-TDR-64-167; SR-123; AD-609477)

The type of testing discussed in this report is that which takes place for every field installation to ensure that implementation of system components is accomplished properly and that optimum system performance is obtained. Implementation testing is defined; it is contrasted with other types of testing; its motivation is discussed, and its planning requirements are outlined. This study reveals how designing an implementation testing program in advance is an effective way of ensuring and accomplishing the successful implementation of the system in the field, at each location where its components are installed. Author

N65-16104*# National Aeronautics and Space Administration, Washington, D.C.
[SPACE AGE: ITS STIMULUS TO THE TOOLS AND PROCESSES OF SOCIETY] News Release
James E. Webb 5 Feb. 1965 14 p Address Presented to the Nebraska Wesleyan U., Lincoln
Available from the Scientific and Technical Information Division

Mr. James E. Webb discussed the challenge of the space age to mankind. The threshold of a new age finds expression in university research and teaching, in government, and in industry. It means much more than a race to the moon or an adjustment to the notions of ultimate speed in travel. The character of the space age affects the roots of our national life, the significance of our security and power; and it stimulates the tools and processes of the Great Society. The power to survive as a great and vigorous society is in process of being proven again through our space efforts. G.G.

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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